

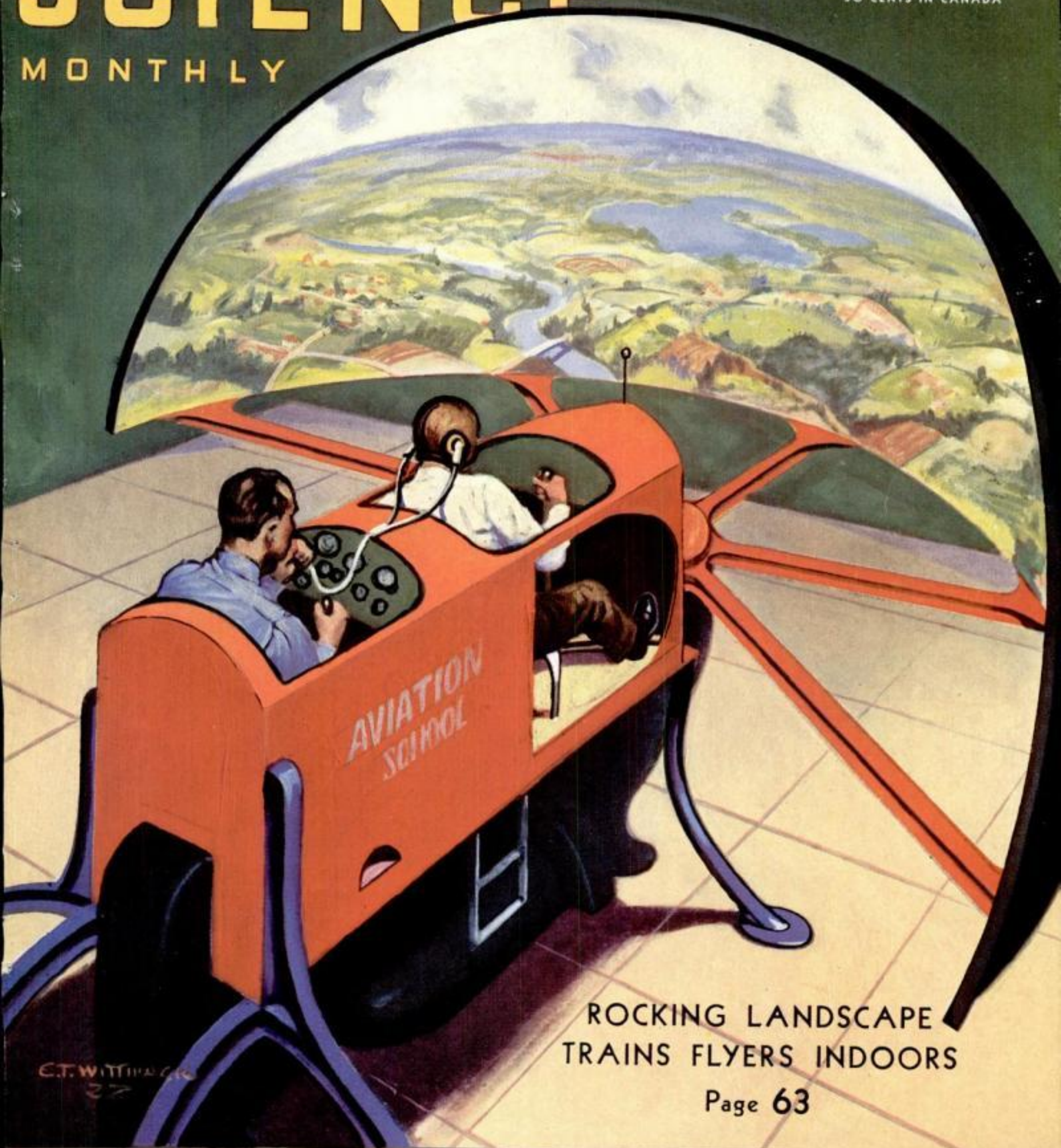
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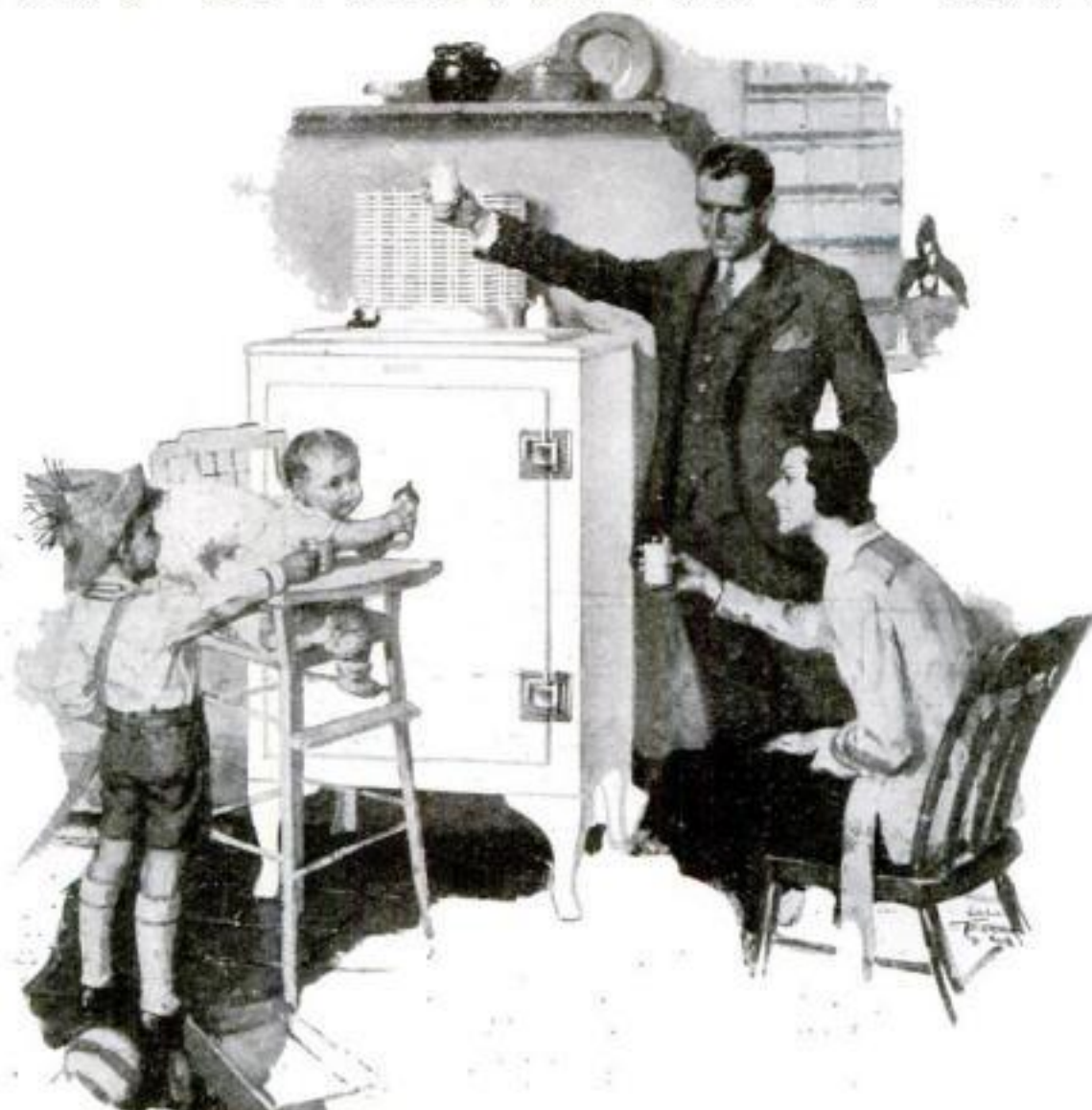
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381 Fourth Avenue
New York, N. Y.

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Man Collects "Library" of 35 Fine Pipes

Yet Swears By ONE Tobacco Exclusively

Mr. Calvin L. White of Clairton, Pa., is an ardent pipe smoker. To him, a good pipe and good tobacco offer the only *real* smoking satisfaction, and he leaves no stone unturned in his search for the happiest combination.

In fact, in his search he has collected a "library" of thirty-five fine pipes. But his search for a "good tobacco" ended long ago. Let him tell you about it—

608 St. Clair Ave.,
Clairton, Pa.
June 29, 1931

Larus & Bro. Co.
Richmond, Va.
Gentlemen:

I am very much a pipe smoker, because a good pipe and good tobacco offer the only real enjoyment I can get from a smoke. While it is true that a good pipe has a lot to do with a good smoke, the wrong kind of tobacco spoils everything for me. My collection of pipes consists of thirty-five, and all of them are considered fine ones. But when it comes to tobacco, I stick to one brand exclusively—and that is Edgeworth.

My advice to any man is this—get a good pipe, a can of Edgeworth, and enjoy the real comfort and satisfaction that smoking has to offer.

Yours very truly,
Calvin L. White

Why not take Mr. White's advice? Try a good pipe and a tin of Edgeworth Smoking Tobacco. There seems to be something about this cool, slow-burning smoke that makes men "write home about it." Perhaps it's that special Edgeworth blend of fine old burleys with its natural savor insured by a distinctive and exclusive eleventh process.

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Safety Last Is Safety LOST!

By LEON MEADOW, *Financial Editor*

PAUL GARDENER and his father-in-law, Bryant Colton, had the living room of Paul's house to themselves. Alice, Paul's wife, and her mother were busy in the kitchen tidying up after supper. The chill of the winter evening had been dispelled by a cheerful blaze in the fire-place grate, and both men studied the colorful flames in silence.

Finally, Colton said, "Paul, I'm thinking of putting a thousand dollars in my safe deposit vault tomorrow."

"In the vault!" cried Paul in astonishment. "Are you crazy, Dad?"

His father-in-law smiled. "Not at all, my boy—but I can't see anything else to do with money these days. For the 3 or 3½% interest you get in the savings banks, I don't think the worry of keeping it there is worth it."

"I don't see your point, Dad. Nothing could be safer than a large, reputable savings bank. But even if you think the worry of keeping money there overbalances the interest to be gained, why don't you consider bonds? Good bonds are just as safe, and the return, from 4% to 4½%, is attractive enough to make them more interesting from that view point."

"Bonds?" the older man questioned. "Why they're in the same boat as common stocks! Just pick up today's paper and look at the bond market quotations—you almost need a magnifying glass to pick out a number over 70!"

Paul laughed. "This is rather funny, Dad. From all traditional standards, we're both on the wrong side of the fence. You, the elder of us two, brought up in a more conservative age, should be the first to praise the virtues of bonds; while I, by all rights, should be the one to shout them down. But what's more, I'm going to continue on my side of the fence—if you think you could stand a little moralizing without falling asleep."

"I promise you I won't do that," his father-in-law answered. "Being connected with a bank, you should know what you're talking about."

"I THINK I do, Dad—and I think that a lot of men like myself have come to the same conclusion. It may be old stuff—but never before have I been more firmly convinced of that dark cloud and silver lining proverb. I'm talking about the depression. A huge army of so called 'investors' have undoubtedly paid one of the highest prices in the history of finance for their mistakes. Now, let me go back to the beginning of my story."

"For a long time—perhaps since the end of the world war and the changed economic conditions it brought—the aver-

age investor's error has been that he never honestly wanted to be an investor; but consciously, if he bought common stocks—and unconsciously, if he bought certain types of bonds and preferred issues—joined the ranks of the out-and-out gambler. And yet, this last group would be amazed if you called them gamblers. They have bought bonds and preferred stocks, and so class themselves as investors. But are they? Did they buy bonds yielding 4 or 4½%? No. First they looked for 6 or 7%—and if the security yielding that happened to be a bond, then they became investors. In other words, I'm driving at this point: they may have been looking for safety—but not for safety *first*. Most likely they persuaded themselves that so long as they included the word 'safety' in their programs—though not giving it the first and exclusive place—then they were all right. But the lesson of the last year has taught them in a most unpleasant way that as soon as they put safety in second or third place, they *lost* it entirely."

"LET me interrupt you a minute, Paul. I can see from what you've said so far, that your argument hinges on one point which is not exactly clear to me."

"What's that, Dad?"

"Well," Paul's father-in-law replied, "I can see that you have in mind two types of bonds. The ones you've just attacked—and the ones that I presume you consider safe investments. What's the difference between them?"

"I was going to discuss that a little later, but since you've brought it up, I might as well explain it now. United States Treasury Bonds and Notes are safe. Their interest yield may only run from 3¼ to 3¾%—but they're safe, with a capital 'S'! And what's more, people who must absolutely consider safety as the first and possibly only factor in their investments, whether they realize it or not, should be content with that yield. They were, 15 and 20 years ago, and these things haven't altered much—as this prolonged crash has probably taught a great many sadder but wiser men. The first mortgage bonds of our great rail roads, yielding about 4%, are safe. These are what are known as underlying or senior securities because they have priority or first call when it comes to paying of interest or capital, or both. These are safe bonds. These are the bonds in which large corporations, insurance companies and banks, looking for absolute safety, invest their money."

"Bonds aren't very different from most any other commodity. In business and consequently in (Continued on page 5)

SAFETY LAST IS SAFETY LOST

(Continued from page 4)

the realm of securities, all values are according to price. If you want a good chair that will last a life-time, you have to pay the price for it. If you pay less, you're going to get a chair that will fall apart mighty soon. The same truth applies to security buying. People should remember that the more safety they want, the more they have to pay for it. The higher the income on a bond, the smaller the safety.

THAT brings me back to the depression—and one of the many lessons to be drawn from it. You know, as well as I do, how badly the railroads have been hit during the last year or two. Yet, in spite of all these disastrous results, investors who purchased high grade senior railroad bonds—first mortgage bonds—underlying securities—or call them what you will—these people still find their incomes from such bonds unimpaired—and their capital investments reduced only to the slightest extent, if at all.

"Now, take these same railroads, and consider the case of their other bonds, consisting of junior mortgage bonds. These are secured *only after* guarantee and payment of their senior or underlying mortgage bonds—and also their debenture and convertible bonds, which are totally unsecured as to principal and interest—all yielding anywhere from 5 to 6½%.

On the great majority of these, not only the income, but the principal as well have been reduced practically or literally, in some cases, to the vanishing point. And I'm not talking about second-grade railroads either. I have in mind two of the largest systems in the United States—and therefore, in the world. Their junior bonds have suffered severely—and caused their buyers enormous worry, if not serious financial trouble, although many people five years ago thought that such bonds were perfectly safe because they represented the obligations of such excellent companies. It may have been a bitter way to learn, but the depression certainly has taught many of these people 'the error of their ways'. And that error was in thinking that junior or second grade bonds—simply because they were called bonds—could ever have the safety and protection of well-guarded Treasury Notes or First Mortgage Bonds."

Paul paused to light a cigarette, and, then turned to study the fire, in silence. His father-in-law, after a few minutes of reflection, spoke. "That's very interesting, Paul. Never having paid much attention to finance and securities and all that, I suppose I have the average man's knowledge—and also ignorance—about these things. I mean, stocks have been stocks to me—and bonds meant bonds. Up till the present time, the first I knew was a gambler's playground—and bonds I had always looked upon as the true investors' market. Then when I saw so many bond prices topple way down, I lost confidence in them, as well. But now I see my mistake. There are *bonds* and *bonds*! But tell me this, Paul. If all you say is true, and I believe it is, (Continued on page 6)



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SAFETY LAST IS SAFETY LOST

(Continued from page 5)

what's the reason for second-grade bonds? Are they issued merely to lure the would-be investor because of their higher yield—or do they really have their place in the scheme of things?"

"Don't get me wrong, Dad. Second and third grade bonds are not entirely the evils I have made them out to be, although they do spell danger for the investor of small means. There is a place for this type of security, and not a bad one at all. Second grade bonds may be rather good holdings for the large investor who can afford to have a large portfolio of securities which are well diversified, to cover many types of investments. In such a portfolio, the investment of a *minor* part of the total funds in such speculative bonds is permissible, and sometimes quite advisable. But that's entirely another story and has no real place here. However, under no condition would these bonds be the proper kind to constitute the *bulk* of any portfolio, and surely they should never be carried *at all* by the investor of small means, who must protect these means and their income by strict adherence to the high standards I have tried to outline."

Paul stood up. "That's enough finance for tonight, Dad," he said, "... and I've talked too much already. Let's go in the kitchen and see how the fair sex is progressing with the dishes."

PAUL GARDENER packed a lot of cold, sober truth in the short talk he had with his father-in-law. Another moral he might have drawn, another silver lining he might have found is the realization that our best teacher is the error which brings us the painful experience of learning and admitting what we should have and could have avoided.

In normal times, when things are riding smoothly and easily, too many of us are prone to overlook the sound sense of what Paul Gardener said. And if it does take an economic depression and a setback of the size of this present one to realize the wisdom of his words, then there must be such a thing as a silver lining. The big point is this—if your savings are small or average in size, be wise and do everything in your power to guard them well. Keep your surplus money in a sound savings bank and be satisfied with 3 1/2 or 4% interest per year. That's a good, sensible yield, and anybody looking for safety, had better not look for much more interest. Or, if you do need more, buy only the very best mortgage bonds of the strongest corporations, bonds that yield 4 or 4 1/4%. And if you are fortunate enough to be a man of more substantial means, don't endanger your position by going into second or third grade 6% and 7% domestic bonds or 7% and 8% foreign bonds. As to preferred stocks, always remember that they are of *necessity* even weaker than junior bonds.

The years 1930 and 1931 have taught us all a lesson which may later prove of immeasurable value to us because of the experience they provided as to the rules of sound investment. (Continued on page 7)

Famous Anachronisms



Solomon was wise He was *THERE* with a **CROSLEY RADIO**

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SAFETY LAST IS SAFETY LOST

(Continued from page 6)

For the past three years POPULAR SCIENCE MONTHLY has carried this Getting Ahead Department as a regular monthly feature. It has been the aim of the editor to discuss financial subjects of interest and application to the average man or woman.

The financial editor would welcome letters from readers indicating subjects in which they have particular interest. Letters relating personal experiences in getting ahead, or giving the details of plans or methods which have succeeded, or failed, are also welcome. We extend this invitation to write us as a means of making this department of greatest usefulness to our readers.

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cream, to glue, and tobacco. We recommend these advertisers to you. There is so much real information in their announcements in this magazine that readers of Popular Science Monthly will find them not only interesting but decidedly helpful as an index of the most modern and practical devices and developments.

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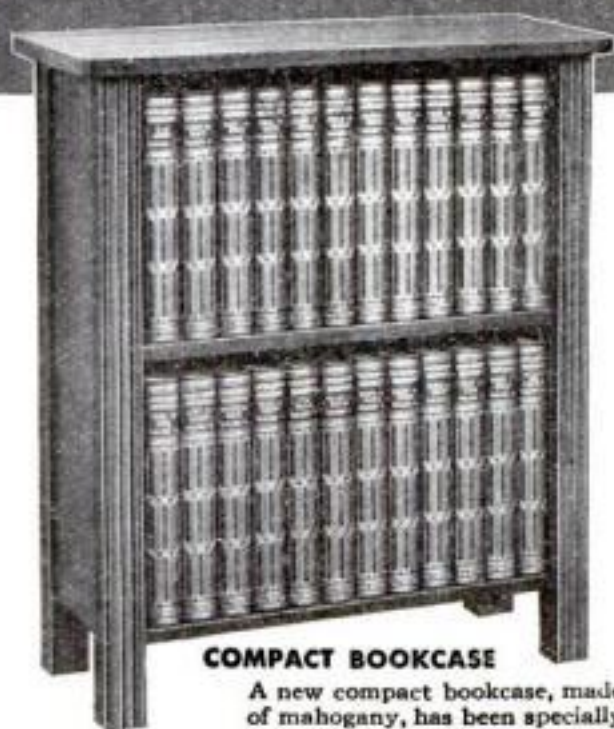
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N. Y. University
Director, Popular Science Institute

There's

Real Danger *in* Poor Tools



Poor tools are a danger to user and bystander and over three thousand accidents occurred in New York State alone in a year as the result of defects in tools or of their wrong use

JUST from the standpoint of efficiency and lasting ability, it would seem that there are enough arguments in favor of good tools to insure their selection every time, but there is another factor that makes the use of good tools advisable, and that is safety.

It is a temptation, particularly when one rarely has use for tools, to pick up cheap ones that will "do for the time" and figure that any larger expenditure is unwarranted. But these cheap tools are not entirely safe; and, particularly when they are called upon to do work for which they are not intended, their use involves certain hazards. Using a monkey wrench as a hammer, a screw driver as a lever, or a hammer as a mallet in chiseling may result in serious accidents.

The fact that 3,868 compensated accidents in one state (New York) in one year were caused by defects in hand tools or the misuse of such tools is proof of the actual danger of using poor tools. Robert Northrup, in the *Industrial Hygiene Bulletin*, says:

"A cheap tool is prone to be an unsafe tool. Purchase tools from those concerns who are making every effort to produce the highest standards in their departments—where the steel to be selected for various tools and its best method of tempering is studied, and where the finished product is tested under practical working conditions."

Not long ago, Mr. Northrup, who is Safety Inspector for the Bureau of Industrial Hygiene of New York State, sent me a cheap set of tools to be put through the regular tests employed by Popular Science Institute in investigating tools. There were five tools in the lot and only one was found to be any good. The first

thing we did was to put the hammer in a special machine in the laboratory which reproduces the repeated blows to which a hammer may be subjected over a period of time. Records of tests on good standard carpenter's hammers made by Popular Science Institute indicate that no hammer head should be loosened or the wedges moved under an average of 7,000 blows delivered in forty-five minutes, but the head of this cheap hammer flew off the handle on the fifteenth blow within ten seconds of starting. It is obvious what damage this hammer might have done to anyone standing near a person who was using it.

When we put the hatchet, submitted in this set of cheap tools, through the same blow test, the handle flew off after thirty-five blows, when it should have stood for at least 5,000. The claws cracked and chipped away before the head came off, showing extreme brittleness, which is to be expected of cast iron, the head being made of this material, with an inserted cutting edge of inferior steel.

THE next tool tested in this set was a screw driver. It was found that, while finish and temper at the tip were not all that could be desired, it could not be condemned as a poor tool. However, when a screw driver is inferior it presents especial danger since about ten percent of the hand tool accidents are caused by screw drivers. Probably the reason for this is that the screw driver suffers the most misuse and may become defective the quickest. It is wrongly used as a chisel, hammer, drift pin, lever, tack puller, and in many other ways.

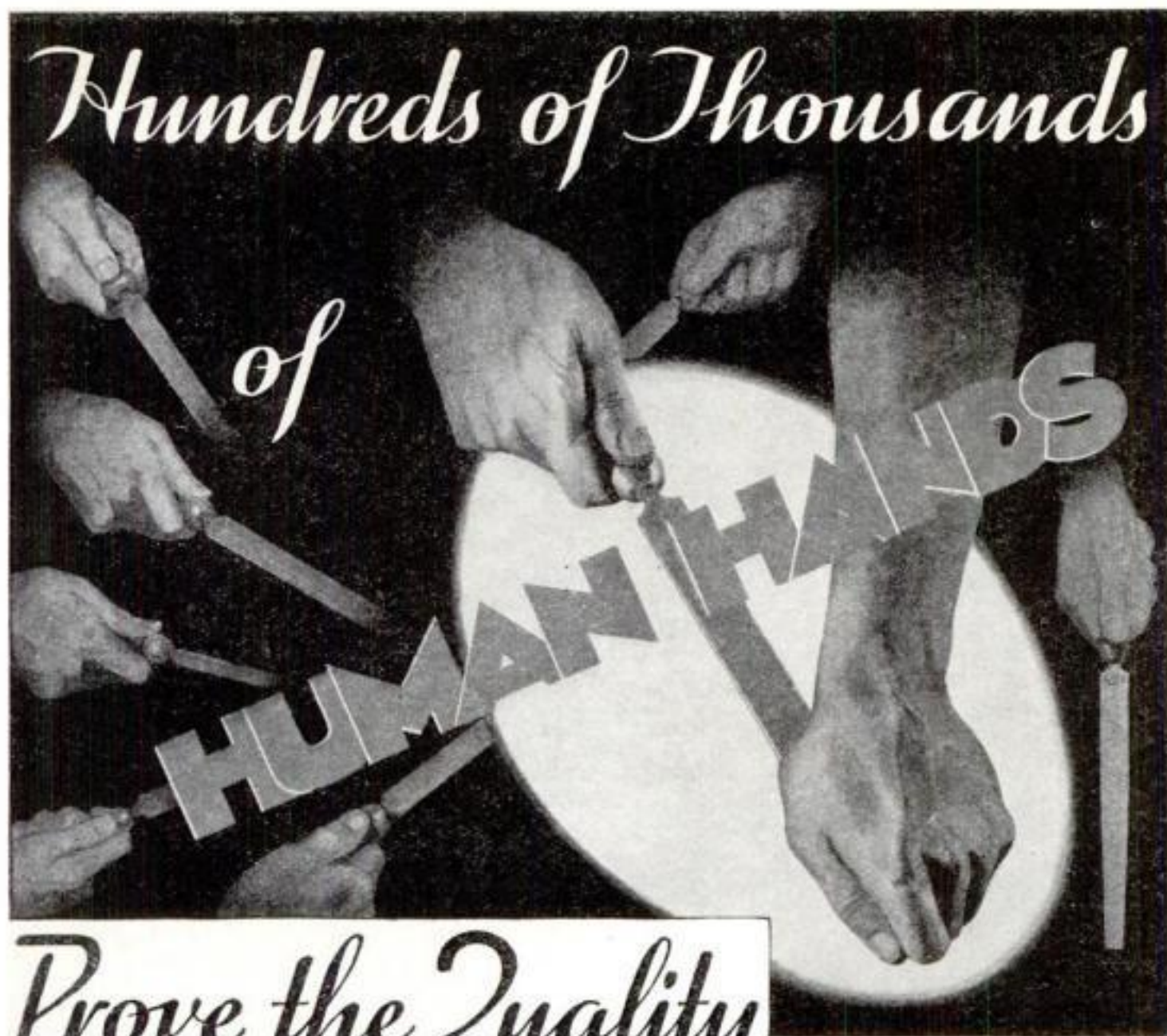
An eight-inch hack saw blade, also submitted, was subjected to a usage test and

to a hardness test. It was found that this blade was of fairly uniform hardness but of poor material and deteriorated rapidly. Three stone mason's chisels were the last tools in the set to be tested. These were found to be of extremely poor quality material. The smallest of the three appeared to be of steel, but extremely hard and a great source of danger due to brittleness and overhardening.

THE results of these tests indicate plainly enough that cheap tools offer little to any buyer looking for either service or safety. What applies to hand tools applies also to power tools. Popular Science Institute has found, in testing tools of the latter type, that safety is one of the most important points to check, the "on" and "off" switching control being an essential feature to watch out for. Accidents have been reported where saws have been dropped and a man's foot nearly cut off; drills have been laid down on benches and persons have come in contact with the business end to the detriment of clothing and possibly also to hand and body.

The Fire Underwriters Laboratories in New York will approve no tool that does not automatically cut off the current when the tool leaves the workman's hands. This is as it should be, but not all are so manufactured, although the leading producers of the better grade of tools have met this requirement.

To every user of tools, professional or amateur, Popular Science Institute recommends (1) that he buy good tools, (2) that he have a kit complete for all kinds of work he may do, and (3) that he use these tools for the purpose intended and for no other.



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Our Readers Say



Do Potatoes Grow Bigger When Planted in Moonlight?

RECENTLY I got into an argument about the signs of the zodiac and the effect the moon has on growing things. I based my argument against the moon on what was said in your recent article on astrology. My opponent insists the signs of the zodiac exert some influence upon the growth of things and the amount of blood in any part of the body at different times. How about getting somebody, perhaps the author of the astrology article mentioned above, to write an article telling us what science knows about such a force? You might upset a lot of old superstitions.—F.B.N., Bottineau, N. D.



They're as Near the Truth as Anyone Can Get Now

ON "OUR READERS SAY" pages has appeared a good deal of criticism of the articles on the origin of life, heredity, and evolution. I heartily disagree with the critics and I believe those who have studied the question will agree with me that these articles are based on the truth. God has seen fit to give man many scientific instruments through which he may discover how to better human life. As soon as your magazine arrives, each of us rushes to get it and you will find us busily reading and discussing these articles. I think it is safe to say that every wide-awake person today is interested in scientific accomplishments. I sincerely hope that you will continue to publish articles of this sort in the future.—V.H.S., Carlisle, Pa.

"Tiny Inventions" Set His Imagination to Work

YOUR article, "Big Fortunes Won by Tiny Inventions," by Aubrey D. McFadyen, in a recent issue made me feel like sitting right down and thinking up some little gadget. It was very good! I think your magazine is great.—P.W., Brooklyn, N. Y.

Story of Aviation Pioneer Makes a Decided Hit

IT'S NOT often I'm moved to waste your time and mine by telling you what I think or don't; but the article on Solomon Andrews hit me right where I live. That was the cat's whiskers and the camel's hump. Your article clarifies the whole subject of flying as nothing else ever had done. If there are other forgotten and unsung heroes of science, let's hear about them. They deserve it—and so do we. Accept my thanks and please listen to my prayers for more of the same. It's stories of that sort that make your magazine distinctive, putting it in a class by itself if I'm any judge—and as long as I spend my good money for POPULAR SCIENCE MONTHLY I certainly qualify as a judge.—J.W.L., Minneapolis, Minn.



That Arizona Meteor Brings Out Another Blast

I WISH to say that E.B.M. and L.St.J.H., of Richmond, Calif., are both all wet about that Arizona meteor. L.St.J.H. says a lot of things to E.B.M. that are incorrect, according to the latest scientific findings. The meteor has been located. It has been definitely established that it hit the earth at an angle. It has been located 1,347 feet below the surface and at one side of the crater. It is estimated to weigh between eight and ten million tons and to contain ninety-eight percent iron with nickel and platinum mixed. A private mining company is arranging to mine the iron on a commercial basis and the figures prove this can be done at a profit. Please tell L.St.J.H. to use more care in the future in collecting his data—especially on something that happens to be in my own back yard.—F.D.B., Phoenix, Ariz.

Here's a Scheme to End Depression in Sixty Days

YOUR editorial in a recent issue under the title "Grain Rots and Men Starve" clearly states present conditions but suggests no immediate solution. I beg leave to insist there is a simple solution. I further claim that my solution will put this country, within sixty days, on a permanent business basis equaling the post war prosperity of 1920. Here is what I suggest: Let the Government of the United States pay every male citizen of fifty years of age and over a monthly pension of eighty dollars. Let it set a maximum price on farm products. Establish a tariff to prevent dumping by other nations, with the proviso that the tariff will be reduced to the lowest possible limit to any nation adopting above mentioned pension system, the monthly rate of which is proportionately as high. Develop a public sentiment that insists the entire pension be spent each month. To get the money for the pension, I suggest a wage tax on male citizens of about five percent in addition to the present income tax. Congress could work out some scheme to raise the rest of the money. I would greatly appreciate it if you would put my proposition before the people in your magazine and invite comment on it.—O.D.E., Galena, Kans.



With Astrology Explained, He Asks About Graphology

GUESS I better write you a letter telling you what I like to read in your magazine. Everything in it is good so I will tell you what I like most. I'm for flying and photography with all I've got. Also, I like to see you bring to light this bunk stuff. Since you have told us about astrology I'd like to know what you think about graphology. I think it's nothing but a money-making scheme. There

is a fellow near here who is running his page in a daily paper. He claims to bring to light your hidden traits. Some that you know nothing about yourself. And besides he requests you to send a dime for your reading. Everybody knows that dimes make dollars. Let us know in some future issue what you think about it.—G.S.H., Pierce, W. Va.

Roaring Through a Solid Sounds a Bit Difficult

SCIENTISTS claim that interstellar space is filled with ether. Recently Sir Oliver Lodge was reported as saying the ether is the most solid substance we can imagine and that it is many, many times heavier than lead or gold. If that is so then all the stars, our own earth included, are embedded in that substance like raisins in a plum pudding. The astronomers state that the stars are whizzing through space. If that is true please explain how it is possible. Are there tunnels in that solid mass through which they are dodging?—G.S., Kaihere, New Zealand.



Congratulations to Two of Our Letter Writers

I WANT to congratulate the authors of two letters that appeared recently in "Our Readers Say." One, and the more forceful of the two, is by S.A.C., Danbury, Conn.; and the other is from the pen of H.E.A., Richmond, Me. I heartily endorse the stand taken by S.A.C., and I should like to ask why the daily papers do not print word pictures of the infamous creatures who buy bootleg liquor and then go home to make life miserable for their innocent families? Why do they give big headlines to a slander that concerns a law-abiding citizen and have so little to say about the real crooks?—J.A.W., Canton, Ohio.

All Right, We'll Bite; How Many Can Get It?

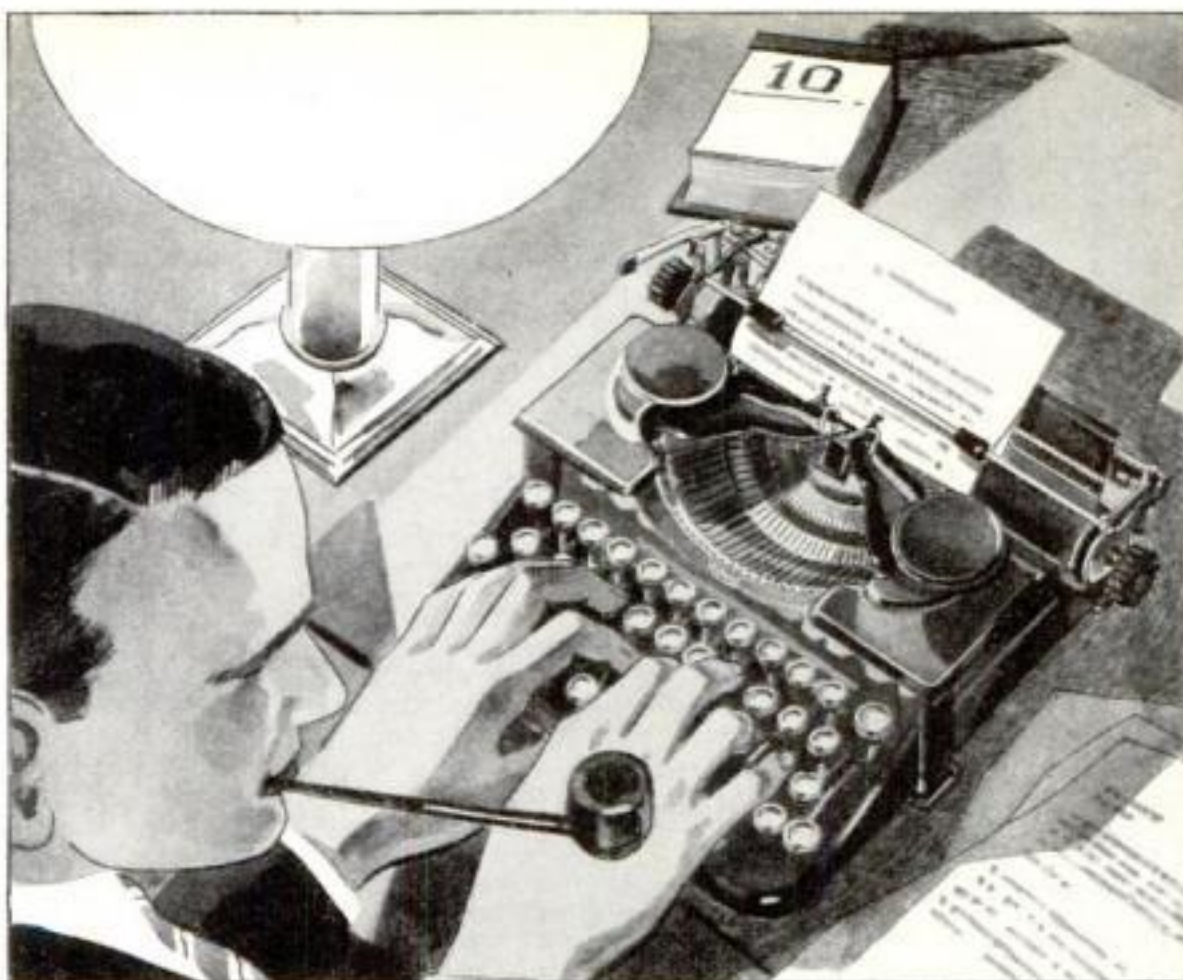
How many of your readers can get the following contradictory problem without difficulty? A says to B, "There probably are 144 apples in your basket." "Don't be foolish," B answers. "If you take the square root of that number the answer obtained will be greater than the number of apples in my basket. In other words, I have fewer than twelve apples." Now suppose A had said to B, "There are twelve dozen apples in your basket." The square root of twelve dozen is about three and a half dozen or forty-two. Or he could have said, "There is a gross of apples in your basket." The square root of one gross is one gross, or 144 apples. Is



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this all clear? How do your readers figure it out? And why does the number of apples appear to change?—H.P., New York, N. Y.

Discourage? No. Just Amuse and Instruct

IN A recent issue of POPULAR SCIENCE MONTHLY there was an article under the title, "Freak Accidents." I should like to know why it was put in your magazine? Was the author trying to discourage everyone? I think the article was rather foolish, as the things it described could happen only once in a hundred years. If everyone had to go about constantly on the watch to avoid being killed by some trifle, there wouldn't be much time to do anything else. We have trouble enough as it is. Let's forget the others. These "freaks" may never happen. With me your magazine goes to the top of the list every time. I especially like the Home Workshop.—G.E.H., Ashburnham, Mass.



"Uncomfortable" Doesn't Begin to Describe It!

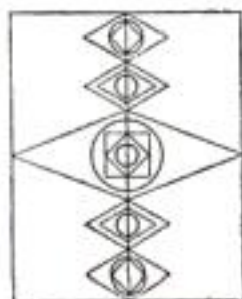
PROFESSOR GODDARD, in his article on rockets in a recent issue of your magazine, said that his air propeller would not work in the thin upper air and that his rocket would be driven by explosions. Everyone knows that propellers throw a blast of wind behind them. Now if this blast would be useless would not his rocket blast also be useless? It can't be that the rocket gas is lighter than the upper air, because nothing is lighter than space. I read somewhere that an aircraft going 200 miles a minute would reach the moon in about eighty-three days. Would it not be uncomfortable for the passengers to be cramped in the rocket for so long a time? If the rocket went much faster the wings would be torn away. Will someone please correct me if I'm wrong.—H.C.K., Cincinnati, Ohio.

Alaska Not Frozen—if You Stay Where It's Warm

I THINK that readers of POPULAR SCIENCE MONTHLY ought to know that Alaska is not all frozen up as a recent issue of your magazine suggested. The interior is frozen all winter but Ketchikan, where I live, has had no snow for two years that stayed on the ground more than one day. We have regular mail service, by boat, all through the winter months. The article was true enough for some parts of Alaska but I think it should have been stated which part.—D.M.D., Ketchikan, Alaska.

Nice Little Problem for the Pencil Pushers

HERE you are, folks. Read it and weep. See if you can draw the design shown here-with, without raising your pencil from the paper, without crossing or retracing a line, and without swearing. This puzzle is original, as I worked it out myself in my spare time. So sharpen your pencil, hustle the wife and kids out of hearing, and get busy. I assure you it can be done—and it's not hard. It's all a little matter of starting out on the right track and then going ahead without making a mistake.—S.S.M., Magog, Can.



Russia too Busy for Trifles Like Astrology

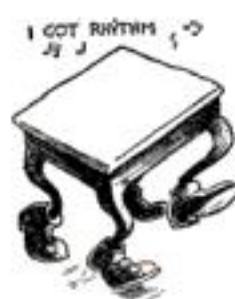
IN A recent issue of your magazine I saw, on "Our Readers Say" pages, much interest expressed in astrology and whether it is a fake. Why are your readers interested in such subjects? What does it matter whether it's a fake or not? Are there people in your country who really believe in such nonsense? We here in Russia have no time to waste on such matters. Even our children are too busy for such foolishness.—A.C., Moscow, Russia.

Big Dipper Overruns Its Circle Each Revolution

OBSERVATIONS of the Big Dipper for some time have led to the conclusion that it appears to describe a little more than one circle about the North Star in one solar day. The overrun is not noticeable to the naked eye in any one day or two, but has amounted to about one quarter turn in the past three months. Ninety degrees in ninety days, or in time measure four minutes per day, is in accord with the sidereal time equation known to all astronomers for the past several centuries. Your Texas prodigy says this is all wrong, but in spite of his grand flourish of finality, I suspect that he has not yet completed a satisfactory revision of planetary periods.—R.D.C., Salem, Ore.

His Table Walked Without the Help of Spirits

I HAVE just read what L.D., of Houston, Texas, had to say in "Our Readers Say" about spiritualism. To make a table walk is an easy matter. Recently at one of our theaters a friend and I had a chance to help a magician who denounced spiritualism. At the theater each of us was fitted with a belt that had a hook in front which, when not in use, lay flat against the belt and was invisible. On the stage my friend and I each sat at the end of the table and an assistant snapped the belt hook under the table rail so that when we stood up the table rose with us and when we walked the table went along. The others at the table didn't realize what was going on. A nice, slick piece of work, if I do say so myself. Is all table lifting some kind of fake? —W.G., Jr., Gary, Ind.



Everything Is Welcome but Incurable Ignorance

I WANT to congratulate you on your fine articles on evolution. They have opened up to me a great store house of knowledge. They have educated me as to what life really is. I wish you would have, each month, an article explaining the principles and aims of biology and physics. In conclusion I wish you would pass on this very wise saying to the readers of your magazine: "This old planet welcomes everything but incurable ignorance."—C.L., Brooklyn, N. Y.

He Gets His Axe Ready for All Our Critics

HERE's where I grind my axe and do my good deed for today. F.C.L., Rantoul, Ill., says that you should discontinue radio articles because they can serve no good purpose because we have our set bought and paid for. When these folks start suggesting that this and that should be cut out of our favorite magazine it seems to me that their heads have stopped functioning and so the axe is being sharpened and we're looking for a

great big basket to hold empty heads. And we hope the editor sticks on the job so we can continue to enjoy POPULAR SCIENCE MONTHLY.—W.A.M., Coeur D'Alene, Idaho.

Working of Autogiro Vanes a Deep Mystery to Him

A SHORT time ago I read in your magazine an article on aviation in which the statement was made that the vanes of the autogiro are turned by the rush of air past them. What I want to know is how this is possible? I figured it out that the leading edge of one vane is cutting into the wind while its corresponding vane is pushed back by the air stream and therefore the thrust of one vane would balance the resistance of the other so they would not rotate. Will some reader, familiar with the autogiro principle, enlighten me through "Our Readers Say" columns?—V.V.S., Maleny, Australia.



Can You Invent It? Is Right Kind of Education

I AM one of your "Can You Invent It?" readers and I am greatly interested in this sort of education. I believe if the child in school, particularly those of a mechanical turn of mind, were given just such problems that he would show the results to the world in later years. The child in school is no longer, if ever he was, taught to think and scheme out things. A child is born with a certain amount of creative ability which in the great majority of cases appears to leave him after he is in school for a time. Actually most children seem to have less creative ability after leaving school than before entering. Why? Because they are educated away from any creative talent they may have possessed. They have not been trained to scheme things out without the help of a teacher.—J.A.R. Mantua, N. J.

Bad as That? We Thought It Looked Real Nice

IN CASE you haven't found out by this time, I want you to know that the cover on your December issue was absolutely terrible. It reminds me of the covers on scientific magazines that are in a class far below POPULAR SCIENCE MONTHLY. The color is horrid. The crudest of all reds against a bright yellow! The only thing I like on the cover is the lettering, which is fine. It's a shame to wrap your fine text in such a cover. This is intended as friendly criticism.—W.D.S., Philadelphia, Pa.

Proving That a Little Jack Goes a Long Way

I LIKE your magazine and I think the guys that do all the kicking and yelling about putting something else in it ought to be given a well-meant kick in the pants. I think D.G.S., New York, is all wet about the Home Workshop equipment costing so much. A dandy little bench saw that will do all the tricks cost me about \$2.50 including the motor. I made a speed lathe for about three bucks. A jig-saw cost two smackers. A drill press probably could be made for three iron men and a motor can be had for a song. Now if D.J.S. thinks a home workshop cost a fortune, he's nuts, that's all.—W.G.H., Boulder, Colo.



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THE BELL SYSTEM offers to the public a new Teletypewriter Service. Any subscriber to this service may be connected, through the teletypewriter "central," to any other subscriber, whether he be around the corner or across the continent. Subscribers can type back and forth by wire, for short or long periods, just as they now hold conversations by telephone.

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New Talking Ear SAVES MEN TRAPPED IN Submarine

Close-up of the under-sea ear which finds the sunken hull of a submarine and lies close against it held by magnetism

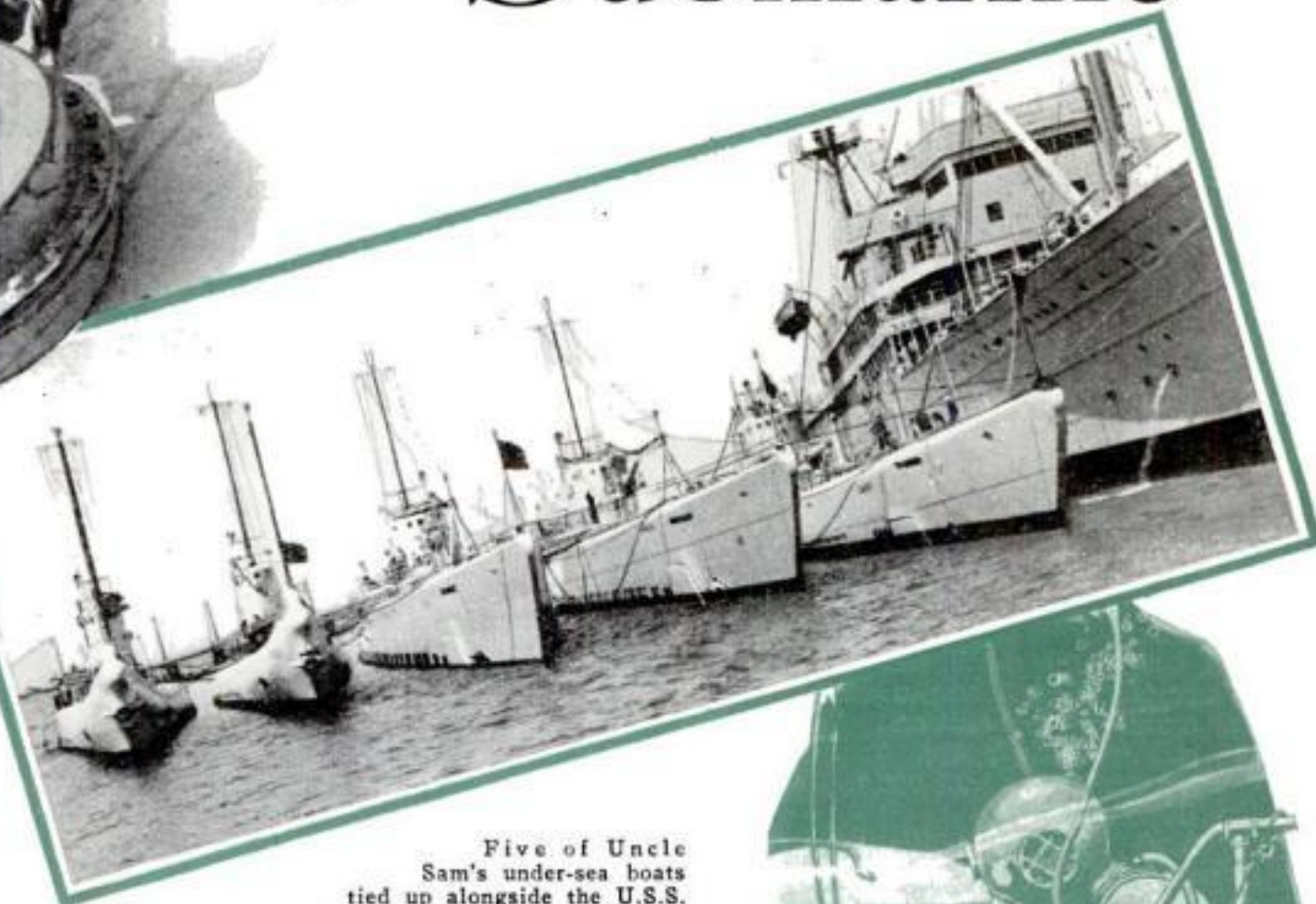
By
*Andrew R.
Boone*

A SUBMARINE crew, trapped in a disabled vessel lying on the ocean's floor, is no longer cut off from the world and doomed to a lingering death. Recent tests made off the Pacific coast prove that the sub's crew can now talk to the rescuers and receive food from them.

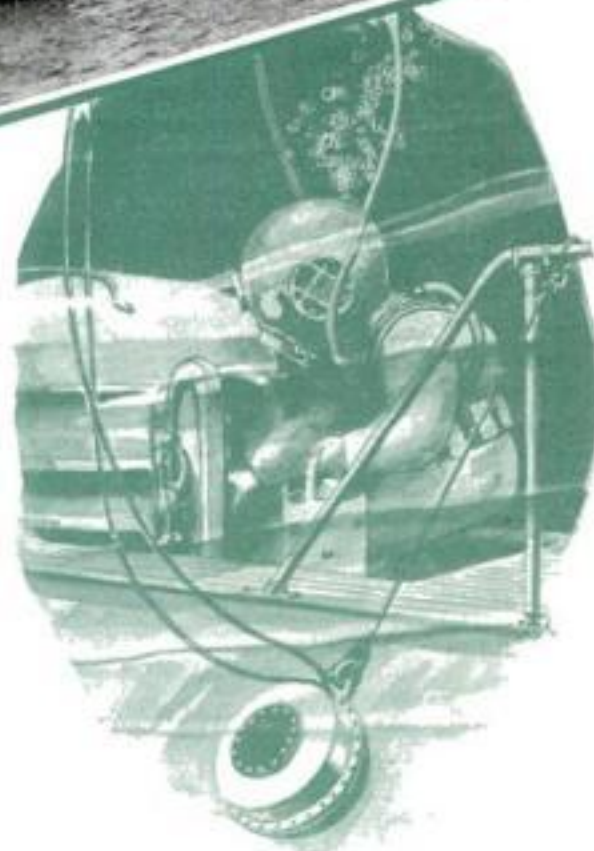
Mechanical ears that automatically attach themselves to the hull of the sunken sub open up an easy means of communication. Water-tight bread boxes carry food that can be passed into the sub through the escape hatch. Over the mysteriously working telephone the entombed men can tell the officers on the rescue

ship what they want and divers with the bread boxes fulfill their requests.

Air lines can be run down, attached, and pure air from the surface pumped down to the suffocating men. More than that, it is believed that liquid food can be sent down through hoses so that the safety and comfort of the crew will be assured. Of course, if the vessel sank far at sea in very deep water this would be impossible, but in the relatively shallow water in which most serious submarine accidents have occurred, the safety and ultimate rescue of every member of the



Five of Uncle Sam's under-sea boats tied up alongside the U.S.S. *Holland*. At right, drawing of diver and "ear" attached to submarine



Capt. W. L. Friedell, commander of Submarine Division No. 12, demonstrates passing of food from rescue ship to the crew of a trapped sub



A sailor adjusting the transmitter-receiver on board the rescue ship, for the purpose of holding conversation with the crew of the submarine which is lying on the floor of the Pacific Ocean

crew, regardless of weather conditions, now seems certain.

Recently I witnessed the functioning of these amazing instruments of safety. From the decks of the U.S.S. *Holland*, mother ship for the powerful Submarine Division Twelve, and from the U.S.S. *Ortolan*, rescue vessel for the same division, I saw the under-sea reproducer attach itself to the hull of the *Bonita*, a nearly-400-foot-long submarine. I watched a diver carry bread boxes of food to the submerged sub.

When the automatic ear goes overboard, and the connections are plugged in, there is silence for a few minutes and then comes the metallic "ping" as the ear strikes the sub's hull. Magnetically drawn to the metal hull, it clings there with the utmost tenacity.

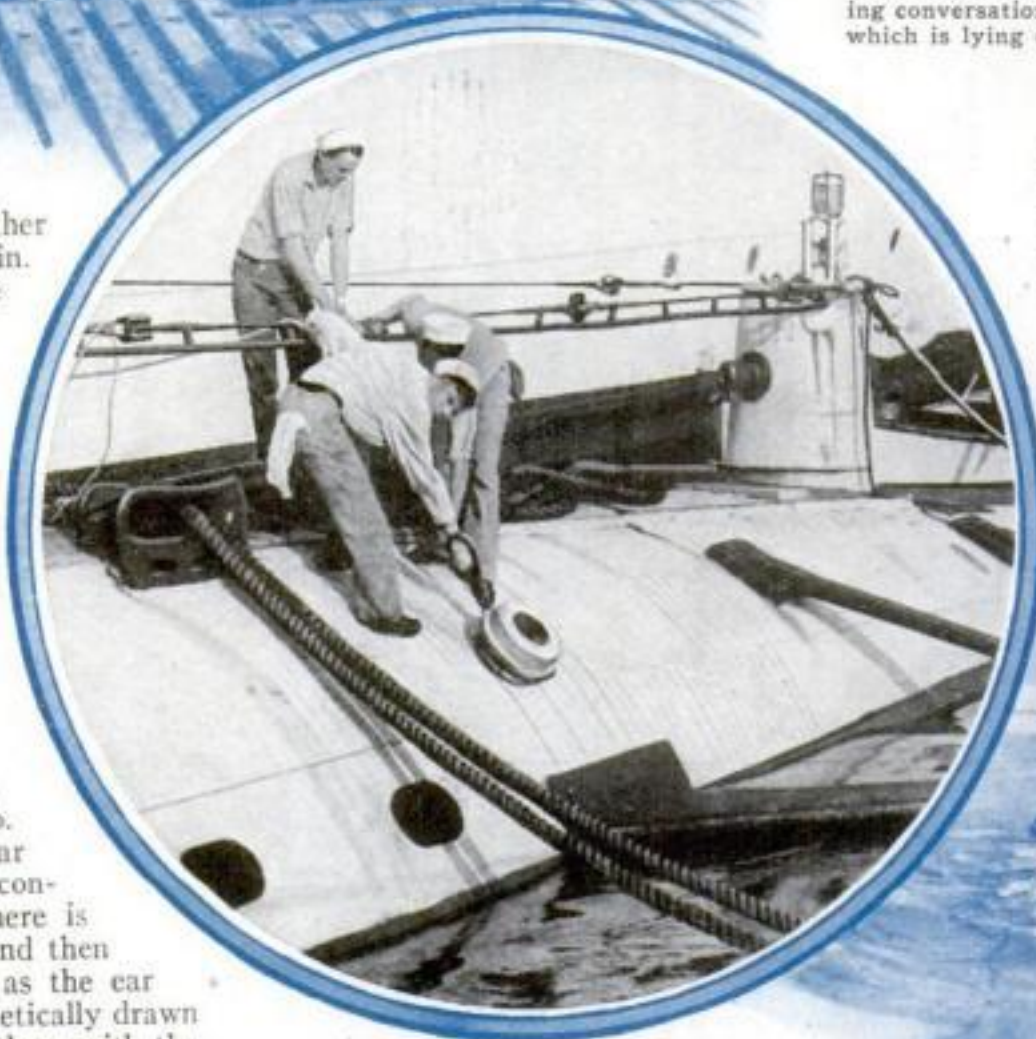
From out of the depth, miraculously, comes a voice. "Hello. Can you hear me?"

The senior officer answers: "Okey. You're coming through fine. Sounds as though you were in the next cabin. We're sending down a diver."

The diver found that the undersea reproducer, the Navy's latest device for communication with the crew of a trapped submarine, had attached itself to metal and hung on. Its use and operation is simple, more simple than the radio broadcasting with which everyone is familiar.

Resembling a huge watch charm, but weighing 200 pounds, this talking ear, which both speaks and listens, contains a powerful electromagnet. When one is dropped into the sea from a rescue vessel, it actually hunts the submarine on the bottom of the ocean. Once it begins to function, it works better at greater depths, down to 1,800 feet, than in shallower water.

These amazing bundles of magnetism and electrical energy have been supplied to all rescue and salvage vessels in the



At left, the talking ear is shown lying flush against the steel hull plates of the U.S.S. *Bonita*. Below, photo shows a sailor who has escaped from the sunken submarine, with a Momsen lung, and climbed up lifeline



Navy. Through portable speaker-receivers set up on deck, an untrained operator, by pushing a button on an ordinary broadcast transmitter, can talk with a crew below even though the sub's power may have been shut off.

Thus, to talk with an officer of a submerged submarine, it is only necessary to attach storage batteries to the speaker-receiver, plug in earphones and transmitter, drop the reproducer overboard, push the button, and talk!

AS THE sound of the voice flows down the cable, it leaps from the reproducer through a quarter-inch of sea water separating the ear's diaphragm from the metal wall of the submarine and passes through the hull plates, which set up vibrations that generate sound waves within the air space of the hull. The hull itself acts as an acoustical receiver.

But how do the men within the sub talk back? They merely speak slowly, distinctly, and a little louder than ordinary. These sounds in turn vibrate the hull plate

to which the reproducer is clinging and their voices leap from the bottom of the sea to the auditor aboard the surface ship.

The underwater reproducer is intended for voice communication between a disabled submarine and surface vessels after the sub has lost its power through disaster or other means. This is the amazing feature of this combination telephone and radio. In the past, one of the acute problems in rescue work has been the continuance of communication, often carried on with much distress to divers operating during storms and in freezing water by hammer-tapping on the submarine.

Before the undersea reproducers were sent to the fleet, a series of tests at Washington demonstrated their efficiency.

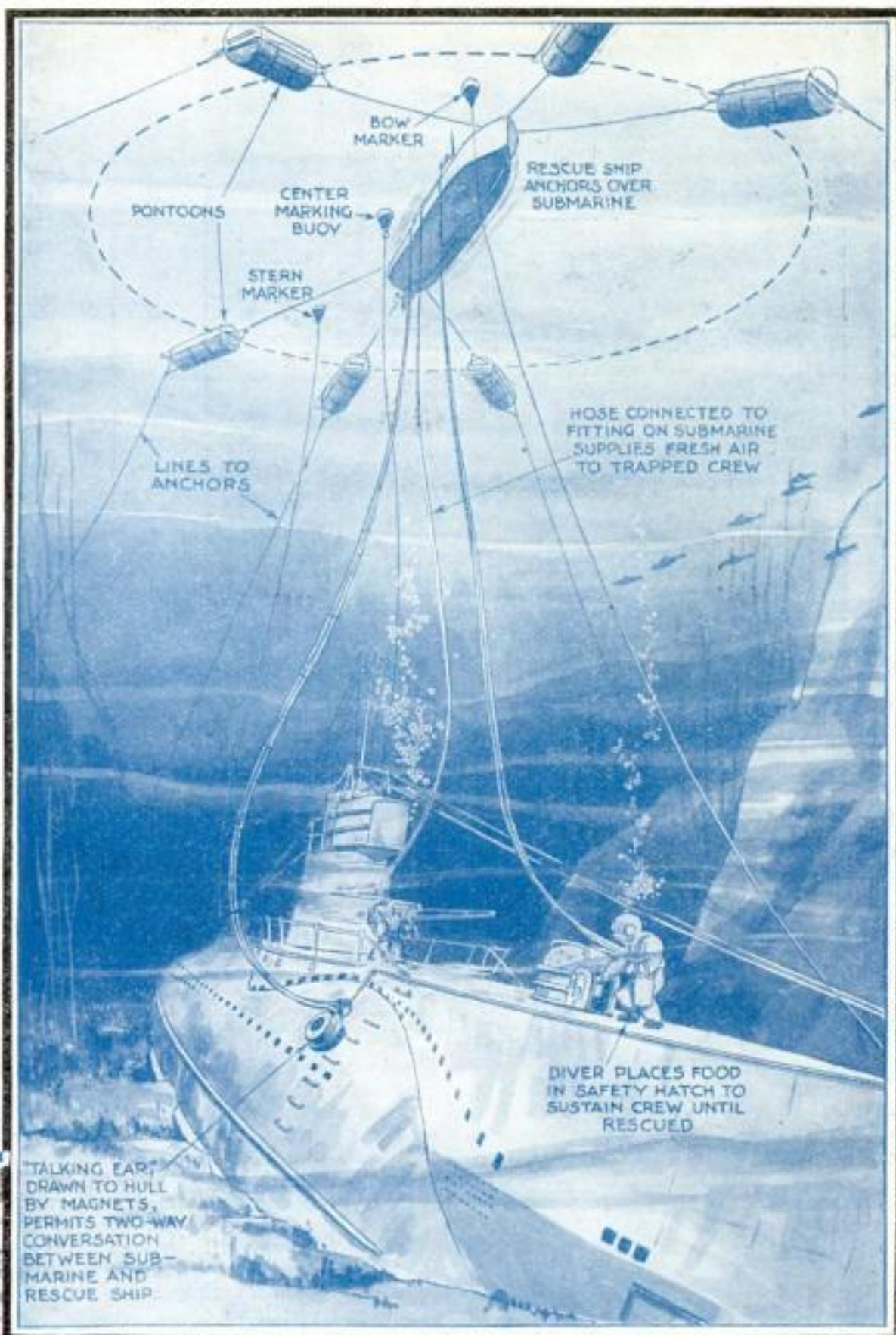
There a decompression chamber, composed of an outer and an inner compartment, was prepared. The chamber duplicated those aboard ship used for decompressing divers by lowering the pressure gradually after they return from a deep dive.

Several men took their stations within the inner room and the water-tight door was closed. Then the floor of the outer compartment was covered with six inches of water. After that, the reproducer was laid in the water, first face down, then on edge against the wall separating the two rooms. The cable led up from the water through the outer door to a portable speaker-receiver. An operator spoke into the microphone. His voice carried up through the water, through the steel wall, and into the inner compartment. The men inside then talked back, and the apparatus functioned perfectly.

THE reproducer talks and hears through both sides. Thus, no matter which diaphragm is turned toward a submarine, the crew will hear its welcome words. The diaphragm does not touch the submarine's hull, however. Practical use with the fleet has demonstrated that the diaphragm functions better when separated from the hull by a thin film of water. For that reason the diaphragms are clamped to the reproducer by cap screws instead of flat-headed screws. The caps stand out one-fourth inch from the reproducer.

In essence, the underwater part of the apparatus is an electro-dynamic speaker employing the two parallel diaphragms which are connected by a tube as an armature. The diaphragms, machined from bronze metal, are seven-hundredths of an inch in thickness. They are at once non-corrosive, to resist the attack of salt air, and non-

Below, a diver returning to the mother ship after delivering food to the crew of a submarine lying at the bottom of the sea. He took down jars of milk, water, and canned beans



Drawing gives clear idea of how the rescue ship, equipped with a talking ear, can drop the reproducer onto the hull of a sunken sub, anchor above it, and through pipes send down food which divers would slip through escape hatch

magnetic. Also packed into the tiny reproducer are the iron magnetic casing or pole pieces, a direct current field coil and core, and an alternating current speaking coil.

From the deck of the *Holland*, I watched a crew ease the reproducer down on the deck of the *Bonita*. In actual use, the device would have been lowered on a rubber covered cable carrying a bronze wire core one-eighth inch in diameter. Attached to the reproducer was a six-foot-long cable, with a clip by which a diver, feeling his way alongside a sub in the ooze, could fasten the device permanently to a submerged vessel. Thus, in case storms swept the sea or the sub rolled over

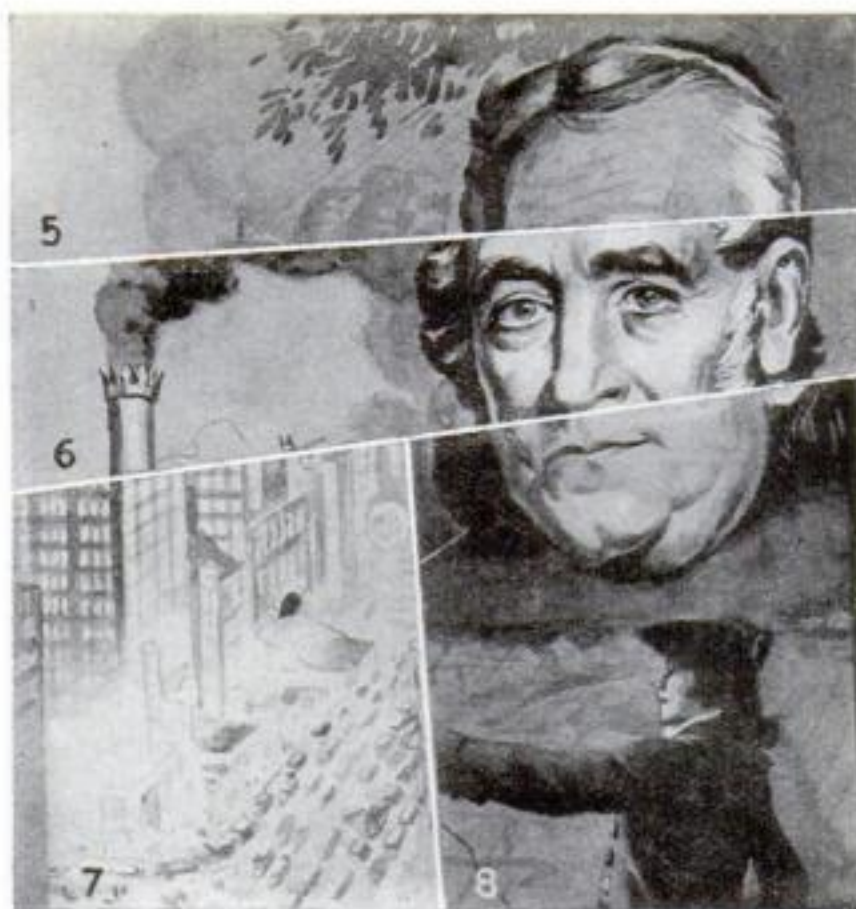
while awaiting rescue, it would not be torn loose from its magnetic mooring.

When the reproducer slid down the port side of the *Bonita*, the magnetism tended to pull it flush against the hull, thus demonstrating its self-contained power and ability to stick.

Only in one case is it felt the apparatus might fail to make contact. Should the search for a submarine be prolonged and the craft roll over and sink in the mud the reproducer, if lowered without a diver, might be dragged over the vessel. In that case a diver would go down to establish contact. Then voices from the deep would reach the surface and continue to be heard as long as the craft remained under sea.

Meantime the crew must be fed. Not long ago the *Ortolan* and the *Bass* demonstrated how this is done.

One hundred feet below the surface of the Pacific, a short distance off the southern California shore, a Navy diver stood on the (Continued on page 130)



When you cut the above pictures along the white lines you will find it easy to assemble eight of the parts into two pictures.

\$10,000 *in* CASH

Do You Know These Heroes of Science?

A POT of Gold! Not an imaginary one at the end of a rainbow, but a real one—at the points of your scissors!

Today ready cash is more welcome than ever. Here is an easy and delightful way to earn a tidy sum. **POPULAR SCIENCE MONTHLY** will pay \$10,000 in prizes to the winners in a brand-new, fascinating game that every member of the family, regardless of age, can play.

The game is on NOW. A novel Picture Puzzle Cut-Out Contest that will give our readers more real enjoyment and, at the same time, will prove more instructive than anything of its kind ever devised, starts with this issue and will continue for six months. Each of the six months, beginning this month, **POPULAR SCIENCE MONTHLY** will award twenty-nine cash prizes to a total of \$1,000, or 174 monthly prizes in all, totaling \$6,000 for the six months. In addition, 71 Grand Prizes, to a total of \$4,000, will be awarded at the close of the contest.

The monthly prizes range from \$500 to \$10. The Grand Prizes range from \$2,000 to \$10. Each contestant can win only one prize a month, but there is no reason why you should not win one of the cash prizes each month, and one of the Grand Prizes at the end of the six months into the bargain.

The object of this amusing and educational game is to find our Heroes of Science and Their Accomplishments. Here's how: Each month during the six months of the contest, **POPULAR SCIENCE MONTHLY** will publish four pictures. Each of these pictures is divided into four parts. Each part belongs in a different picture. The pictures are so arranged that, when you cut out the parts, eight of the parts will give you **TWO COMPLETE PICTURES** of Heroes of Science and Their Accomplishments, if you assemble the cuttings in the correct way.

This is not a difficult job. We will give you clues to the identity of the famous

persons and the work that surround their names with undying fame. If you are alert, you will solve the puzzles quickly and easily.

The prizes will be awarded to those contestants who submit the two correct complete pictures, assemble and mount them in the neatest and most skillful manner, and state the name and accomplishment of each of the two Heroes of Science in twenty words or less. On this basis, \$1,000 in cash prizes will be awarded each month.

When you have assembled the two complete pictures and sent them in to compete for the monthly prizes, **KEEP THE CUTTINGS THAT ARE LEFT OVER**. These cuttings, during the remainder of the contest, will give you **TWELVE ADDITIONAL COMPLETE PICTURES** of Heroes of Science and Their Accomplishments, if assembled correctly. The left-over cuttings must be kept by the contestants during the six months of the contest, and the additional complete pictures sent in at the close of the contest, when the Grand Prizes will be awarded. Each month, submit only **TWO COMPLETE PICTURES IN WHICH NO LEFT-OVER CUTTINGS ARE USED**. Keep all the left-overs until the end of the contest. Then assemble them and compete for the Grand Prizes.

YOU need not be a subscriber or a regular reader of **POPULAR SCIENCE MONTHLY** to compete in this contest. You need not buy a copy of the magazine. You can borrow a copy from a friend or see one at the public library and trace or copy the pictures. You are permitted to get all the help you need from your family, neighbors, or friends, and you may submit as many entries in each contest as you please.

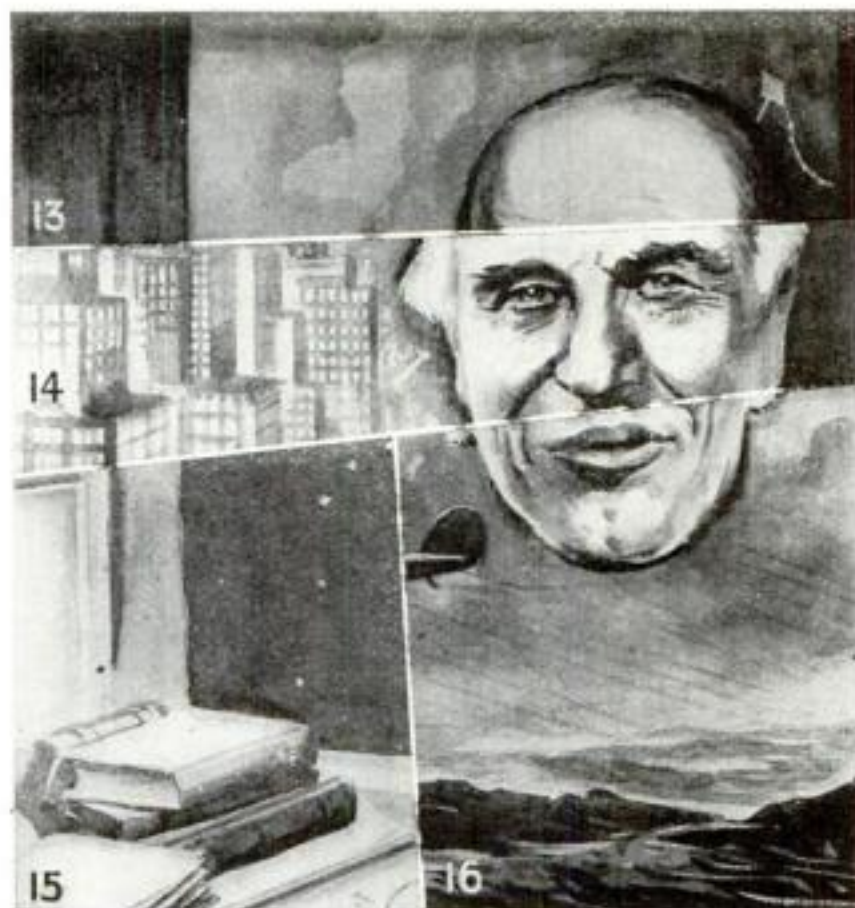
On these pages are the first four pictures. Before you begin work on them, read the rules of the contest. They are simple and easy to follow, but will be rigidly enforced.

MONTHLY PRIZES

First Prize	\$ 500
Second Prize	100
Third Prize	50
Six Prizes, \$25 Each ..	150
Twenty prizes, \$10 Each	200
Total	\$1,000

GRAND PRIZES

First Prize	\$2,000
Second Prize	500
Third Prize	200
Three Prizes, \$100 Each	300
Five Prizes, \$50 Each .	250
Ten Prizes, \$25 Each ..	250
Fifty Prizes, \$10 Each .	500
Total	\$4,000



with eight parts left over. Keep these left-over parts for use in preparing pictures for entry in the Grand Prize contest.

PRIZES FOR SOLVING NEW AND EASY PICTURE PUZZLES

Rules of the Contest—Read Carefully



Marconi, world famous developer of life-saving wireless



Lindbergh, lone eagle of pioneer flight across ocean



Franklin, first American scientist, electrical expert



Stephenson, who led the world in developing locomotive



Edison, America's greatest inventor and wonder worker



Washington; Patent Office opened in his administration

The Men Whose Pictures Can Be Completed Are in Above Group

1. Each month, for six months, beginning this month, POPULAR SCIENCE MONTHLY will print four composite pictures of Heroes of Science and Their Accomplishments. Each set of pictures, when cut apart and assembled correctly, will make two complete pictures with eight parts left over.

2. The pictures must be pasted together. The monthly prizes will be awarded to those contestants who assemble the pictures correctly and in the neatest and most skillful manner. Each of the two complete pictures must be accompanied by twenty words or less, identifying the Hero of Science and his accomplishment.

3. Answers to each monthly contest must be mailed or delivered to the offices of POPULAR SCIENCE MONTHLY not later than the thirtieth of the month following the date of publication of the magazine in which the pictures appear. Thus, solutions of the puzzle in this month's issue must be mailed or delivered not later than March 30.

4. At the close of the six monthly contests, there will be a final contest for Grand Prizes. To compete for these, contestants must carefully save the cuttings left over from the monthly contests. These left-over cuttings, during the six months, will produce twelve additional complete pictures of Heroes of Science and Their Accomplishments, if assembled in the correct way. These additional pictures must not be submitted during the progress of the monthly contests, but at their close. Entries for the Grand Prize contest must be mailed or delivered not later than the thirtieth of the month following the date of publication of the magazine in which the pictures for the last monthly contest appear. This will be the August issue, published July 2. Entries for the Grand Prize contest, therefore, must be mailed or delivered not later than August 30.

5. To receive consideration for the Grand Prizes, contestants must submit not less than twelve additional complete pictures.

6. Grand prizes will be awarded to those contestants who assemble the twelve additional pictures correctly and put them together in the neatest and most skillful manner. Each of the twelve pictures must be accompanied by twenty words or less, identifying the Hero of Science and his accomplishment.

7. In case of ties each tying contestant will be awarded the prize tied for. This rule will be observed in the monthly contests as well as in the Grand Prize contest.

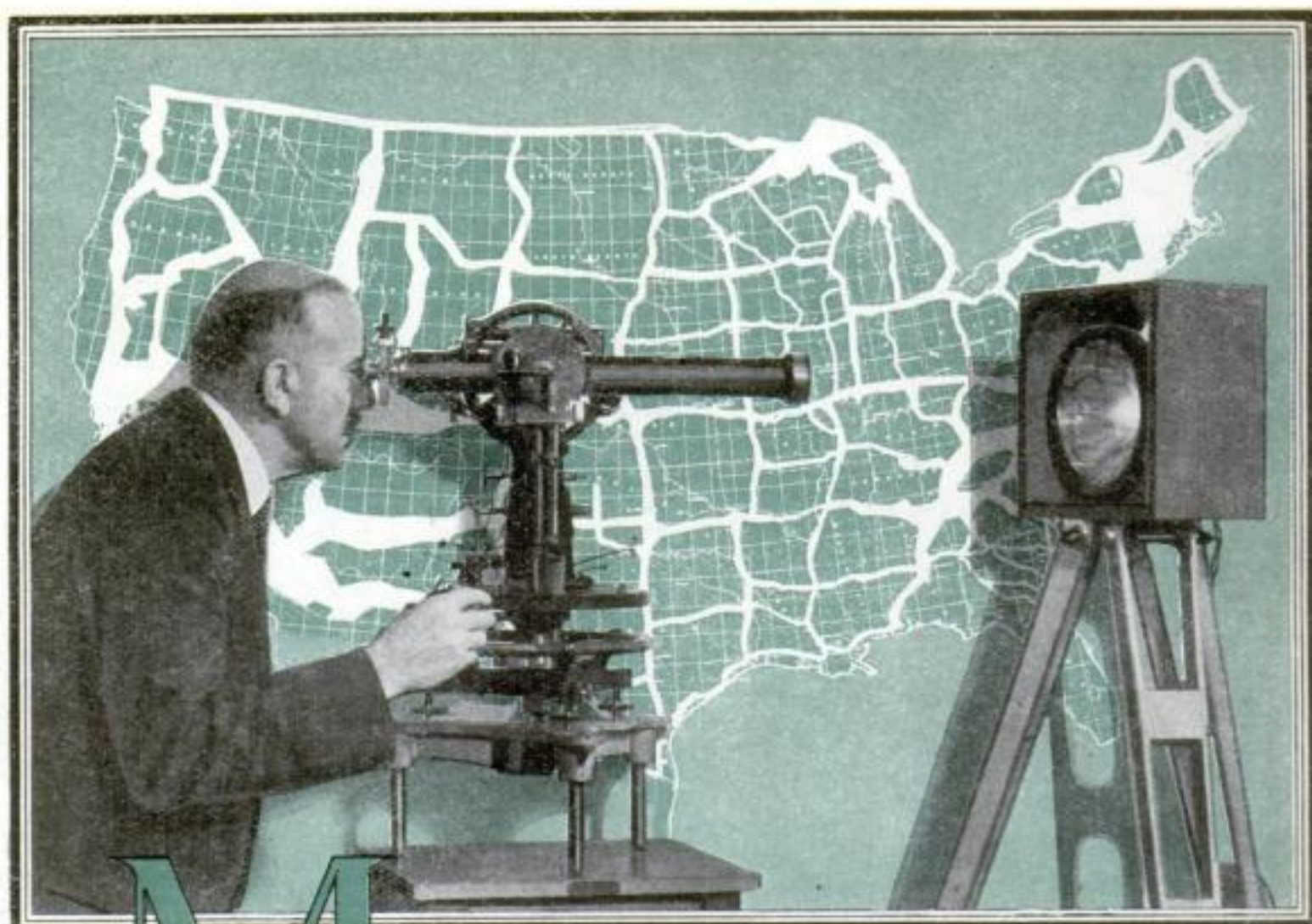
8. All entries should be addressed to the Heroes of Science Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York City. Name and address of the entrant must be written plainly on each page of the entry. Entries with insufficient postage will not be accepted. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be acknowledged, and none will be returned. No letters of inquiry regarding points covered in the rules can be answered.

9. There is no entry fee. You need not buy POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend and trace or copy the pictures, or you can examine a copy of the magazine at any office of POPULAR SCIENCE MONTHLY or at the public libraries free of charge.

10. Each contest is open to everybody, everywhere, except employes of POPULAR SCIENCE MONTHLY and the Popular Science Institute and their families. The officials of the Popular Science Institute will act as judges and their decision will be final.

Broad white lines on the map indicate the areas that have been surveyed to locate accurately the lines between the states. Many of old markers have disappeared, and this work is necessary in running the new lines. Major William Bowie demonstrates sighting lamp and theodolite used in night triangulation work

By
CLAYTON R.
SLAWTER



This geographical center of the United States in Kansas is the reference point for all official surveys for entire North American Continent

M

Measuring the

New Methods and Instruments Bring

"YOU can't tell me a thing about it," said the farmer. "For thirty years I've plowed and dug in that field. If anything's buried there I'd know it."

He was talking to an engineer of the United States Coast and Geodetic Survey. With his assistants, this man had driven up to the farm in a truck loaded with surveying apparatus. He was, he said, tying a new survey into an old Government survey of those parts. In order to do so they had to find a triangulation station of the old work, which was believed to have been buried in the approximate center of the farmer's east forty.

Protesting that it wasn't there, the farmer followed the surveyors across the fields. Skeptically he watched them set up instruments and consult some obviously old notes. One of the engineers squinted through a telescope on an instrument; first at a far-distant church steeple, then at landmarks nearer by. A few calculations were made; then the party's leader

turned to the farmer, saying, "You're standing directly over the old station."

With an expression of scornful amusement on his face, the farmer watched one of the men start to dig. His expression turned to one of amazement when the old station was unearthed. Strangers had come on his ground, peered through a brass telescope, done a little figuring, and then told him what was buried in his own land!

Such incidents are common experiences of field parties searching for old triangulation stations, Major William Bowie, chief of geodesy of the Coast and Geodetic Survey, told me. In surveying the United States, engineers must go back to the dawn of engineering history here. Modern Government surveys, run as part of the titanic task of surveying the entire country, are tied into surveys run sometimes more than one hundred years ago.

So age-yellowed field notes of Mason, Dixon, Washington, Lewis, or Clark are brought from dusty files. Where those early pioneers dragged their chains through underbrush or drove their pack horses over Indian trails, modern parties, instruments loaded on motor trucks, roll swiftly over broad highways. Where Washington or Dixon squinted over the sights of their magnetic needles, the eyes of modern engineers peer through telescopes of transit or theodolite.

Judged by present-day standards, much of this early surveying work is highly

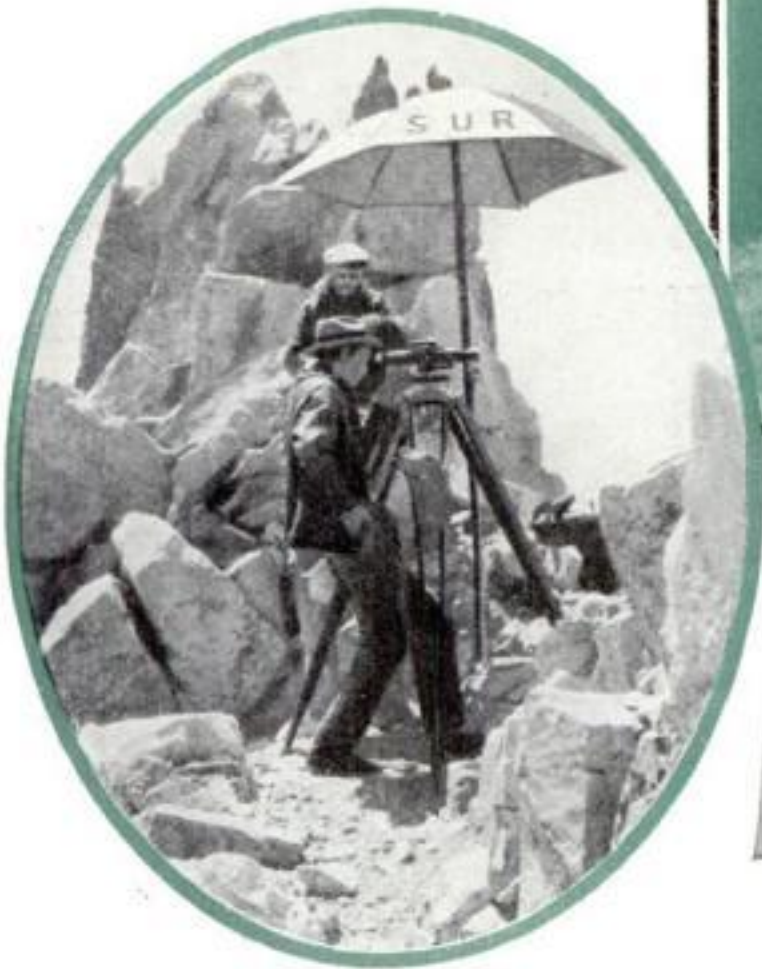
inaccurate. When resurveyed by modern methods, the Mason and Dixon line was found to be as much as 400 feet off in one place. No attempt, however, is made by modern engineers to correct such errors. The original inaccurate line has been a starting point for the work of generations of surveyors, and to relocate its stations and markers now would result in chaos. So highly accurate present-day surveys are tied into the old inaccurate lines.

IN RELOCATING much of this old work, surveyors frequently find triangulation stations and monuments buried by nature or moved by the hand of man. Two of the original markers of the Mason and Dixon line were recently found serving as doorsteps in an old church.

The stupendous task of surveying the entire country today, said Major Bowie, is made necessary by human nature, which is impatient to settle in new lands. When the interior of this country was first opened up to settlers, people moved inland from the Atlantic seaboard with the irresistible rush of water escaping from a burst dam. They took up land where they pleased, regardless of surveys. Where they had an entire continent for their oyster, and where land was to be had almost for the asking, why worry about surveys?

After they had been settled for a while they began to think of property boundaries, which were usually carelessly estab-

Below, a leveling party has reached the top of the United States on the extreme summit of Mount Whitney, Calif., country's highest point



At left, using a tide gage in the midst of a waste of Arctic ice is no sinecure, as the engineers are obliged to live in snow huts and wrap themselves in fur. But no hardship can stop these agents of the Government. Below, Howard S. Rapilyea, of the Coast and Geodetic Survey, displays a few of the bench and traverse marks now used by three nations



United States

Accuracy to Job of Locating State Lines

lished. The first surveyors generally took some prominent landmark, like the steeple of a newly-erected church, and ran magnetic lines from it. What did it matter if there were errors in such work? Where land was so cheap a few feet of difference one way or another was a matter of little importance.

Small communities grew, in the course of time, into large ones with their boundaries and property lines based on such loose and inaccurate surveying methods. Nor did they feel the need of anything better until science, slower in its westward march than empire, caught up with civilization. Towns, no longer independent of each other, were connected by roads, bridges, and rails. Two adjacent towns often were merged into one, with a linking up of water supply systems, sewers, and streets.

The relative levels of two near-by points and the distance between them thus became a matter of importance. Mines were dug, and industrial works built on a large scale. Property values rose enormously. An error of a few feet now meant a gain or loss of great sums of money.

MANY such problems were solved by local surveys, which increased the confusion as the country developed. Look at any map of the United States and you will see, in the boundaries of many states, eternal monuments to just such confused conditions. Notice the line between Con-

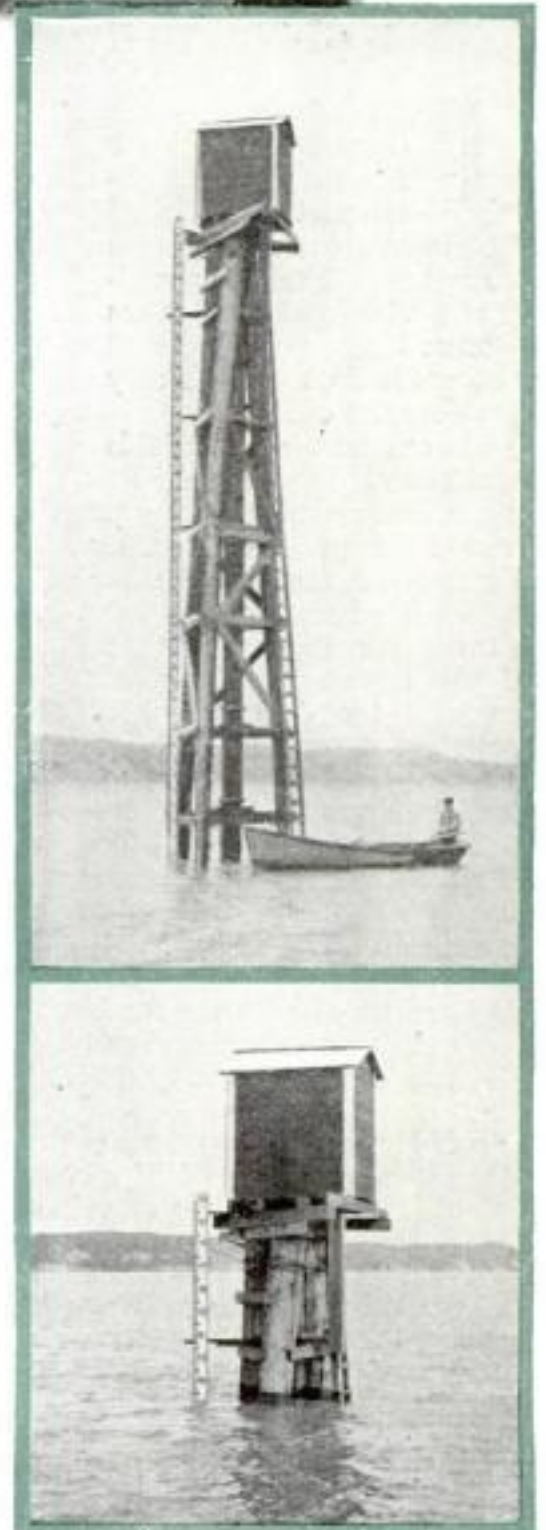
necticut and Massachusetts. Instead of being straight it contains several minute jogs. It is nearly but not quite a straight line because of inaccuracies of early Colonial surveys.

TAKE the case of the line between Texas and Oklahoma, the boundary that runs in a straight line along the one hundredth meridian of longitude. For more than half a century no one knew exactly where this boundary was. Many different surveyors tried to locate it, but they disagreed by as much as 3,699 feet because astronomical methods of determining longitude were then inaccurate.

For a long while the strip of land involved in this inaccurately known boundary meant little to either the governments of Texas or Oklahoma. No settlers lived in it and the ground was so cheap that neither state worried much about it. Finally oil was discovered in that region, and land rose in value so tremendously that the disputed strip became worth many millions of dollars.

Each state then claimed it, and the dispute was carried into the Supreme Court. That body finally ruled that the one hundredth meridian be established with a degree of accuracy that could be accepted as standard by both parties involved in the dispute. The Coast and Geodetic Survey was given this task, and so accurately did it do the work, I was told, that the boundary markers between the two states are not now more than one or two feet off the one hundredth meridian.

Foreseeing just such conditions, the United States Government *(Continued on page 127)*



This tide gage, used by the Coast Survey, is on Cook Inlet, Alaska. In the upper picture the tide is out and in lower it has reached its full height

A COLLEGE on

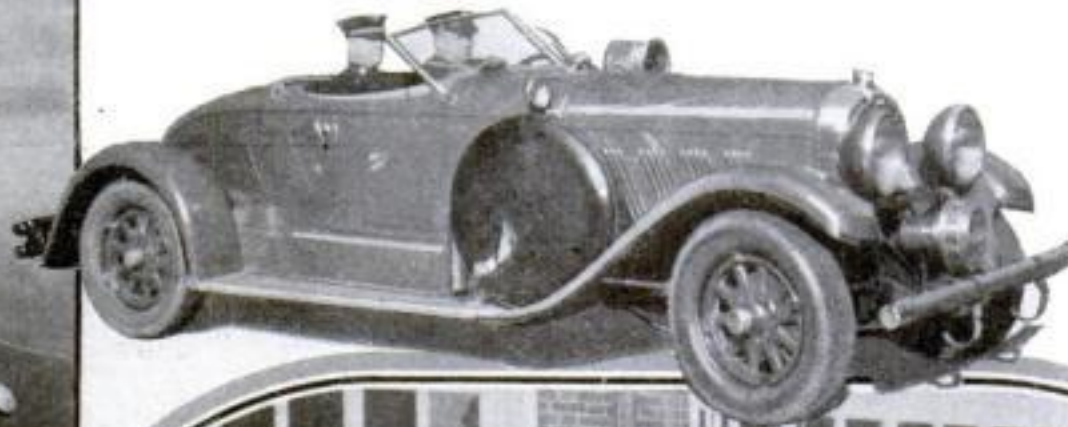
Former Chief, Working with Volunteers,

By

BOYDEN
SPARKES



Former Chief Frank A. Murray, a visiting fireman to the volunteer fighters and an instructor in what to do and how at a fire. Upper right, his speedy red car that has run him to many a blaze



FIRE FIGHTERS LEARN FROM EXPERT

Above, Murray showing a group of volunteers the proper way to lash a big nozzle so it is safe to handle. At right, a drill tower used by the fire teacher in training a class in the use of scaling ladders

pupils were swarming into rubber coats, boots, and helmets. The massive double doors of the fire house were swung open and the apparatus was on its way.

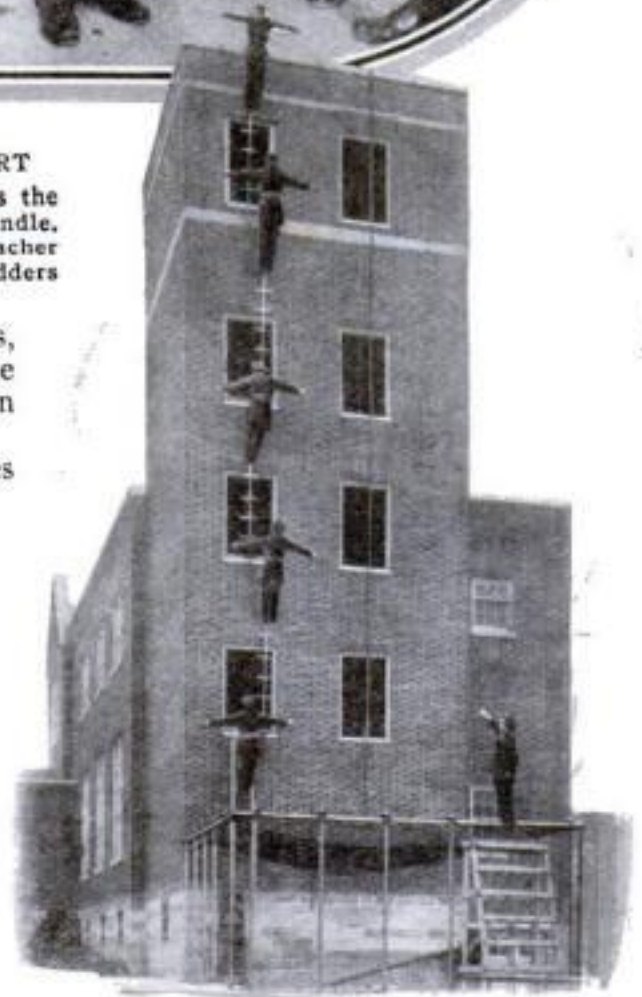
Chief Murray does not travel to fires on the apparatus of his pupils. He rides in his own chief's car, the siren screaming a warning to all traffic to get out of the road. You might suppose that a fire chief in such a situation would be disposed to race his pupils to the scene of the fire; if so you mistake the purpose of Chief Murray. He followed them, this night as always, and so participated in one of the strangest coincidences of his teaching career.

THE alarm had been turned in as a report of a big brush fire that was threatening to sweep across the estate of one of the millionaires of Locust Valley. While the clanging bells and sirens were demanding a clear road the noisy procession came upon another and unreported brush fire. There was the problem, just as it had been propounded by Chief Murray, and the right answer was given by his pupils without hesitation.

Chief Matthews swiftly detached one

unit of his force to battle this second enemy and with the rest of his men and equipment continued to the original fire.

"I was proud of those men when I saw the professional manner in which they dealt with that situation," Chief Murray told me. "Even in pay departments mistakes have been made in similar



THERE are seven thousand volunteer firemen in the eastern part of the United States who are no longer rated as amateurs. They now qualify as professional fire fighters because they have completed a course in the country's only traveling fire college.

The one-man faculty of this institution is former Chief Frank A. Murray, a fireman with twenty years' experience in New Haven, Conn., and an alumnus of two of the nation's most thorough schools of fire fighting. Chief Murray is a graduate of the fire college of the Boston fire department and also attended the drill school of the New York fire department.

A great deal of the chief's work is done in lecture rooms and in demonstrations at the fire department headquarters of his pupils, but his best teaching is done at fires. Frequently his classes are disrupted by an alarm, and when that happens professor and pupils are delighted, not because they are bored with the teaching but because such an emergency call offers the best possible means for practical instruction.

This happened not so long ago on Long Island while the chief was giving a final review lecture to a class of volunteers at Locust Valley.

"What," the chief had asked his pupils, "is the proper procedure if, when you are responding to an alarm with all of your force, men and apparatus, you discover another blaze that has not been reported?"

L. A. Matthews, an electrical contractor who is the chief of the Locust Valley Volunteer Fire Department, was about to answer that question when the alarm bell sounded.

"We roll!" shouted the man on watch. In something less than a split second the

Wheels for FIREMEN

Shows Them How to Fight Flames



It's no use raising a ladder for a rescue unless the fireman knows how to carry the victim, and Murray here is giving a lesson in the right way to get a man down to safety



Raising a ladder from one of the modern trucks is a ticklish job and, at left, Murray shows exactly what to do to prevent accidents and to save time



Chief Murray demonstrates to the volunteers the right way to tie knots in the life-saving ropes

circumstances. Under the stress of excitement fire fighting forces have been known to concentrate their efforts on the first fire they see and neglect, with terrible consequences, the alarm that caused them to roll."

Last year in the course of his teaching work with volunteer fire fighting departments, Chief Murray responded to about eighty fire alarms. Some of the alarms were sounded while he was working with his pupils; others after he had retired for

the night, often many miles from the scene of the fire.

One night he was called out of bed to respond to an alarm in the territory of a freshly organized company of volunteers who were inordinately proud of a new thousand-gallon pumper given by one of the wealthy patrons of the community. Pride and understanding are different matters. In this case the men were fairly itching to see this handsome and powerful piece of apparatus in action.

When Murray arrived the pumper was throbbing and a line of hose was pulsating on the lawn of the dwelling house which was on fire. Flames were roaring out of an attic window. The volunteers were just on the point of throwing a stream of water into the blazing window.

"Wait!" Murray shouted. "Don't open that line!" The firemen looked at him in amazement. "Follow me!" Taking a small chemical extinguisher, Chief Murray dashed into the house and up the stairs.

THOSE who followed close at his heels responded to his order to open the scuttle in the roof. While they were obeying he was squirting a thin stream of chemical fluid into the source of the fire, a wooden box of tinsel and colored paper and other Christmas tree ornaments. In a few minutes the fire was out, with practically no damage.

Right there the chief went into session with his class.

"See here," he said, "your hose line has a nozzle an inch and an eighth in diameter. In five minutes you would have had five

tons of water in that house. Often seventy-five percent of the damage at fires is done by water. You fellows have in your new pumper a fine piece of apparatus, but you must learn to use it with discretion."

Lately I spent a day in the company of Chief Murray at the headquarters of the Elmont Fire Department, which had retained the chief to train them. This is a volunteer organization in Nassau County on Long Island. The Belmont Park race track is directly across the street from the headquarters of one of their five engine companies. Within the grounds of that more than 500-acre racing establishment are stables that shelter from 500 to 1,000 of the most valuable race horses of the country. The protection of those animals, worth millions of dollars, is a terrific responsibility. In consequence the volunteers of the Elmont department had been devouring all the instruction that Chief Murray could give them.

DURING my visit some of the men of one company turned out for a practice drill under Chief Murray's direction. They had been listening to him explain the use of the gas masks that are a part of the department's equipment. Beneath the canisters of chemical substances through which is filtered the air breathed by a man wearing the mask is a small aperture. Chief Murray placed the palm of his hand over the opening.

"Can you breathe?"

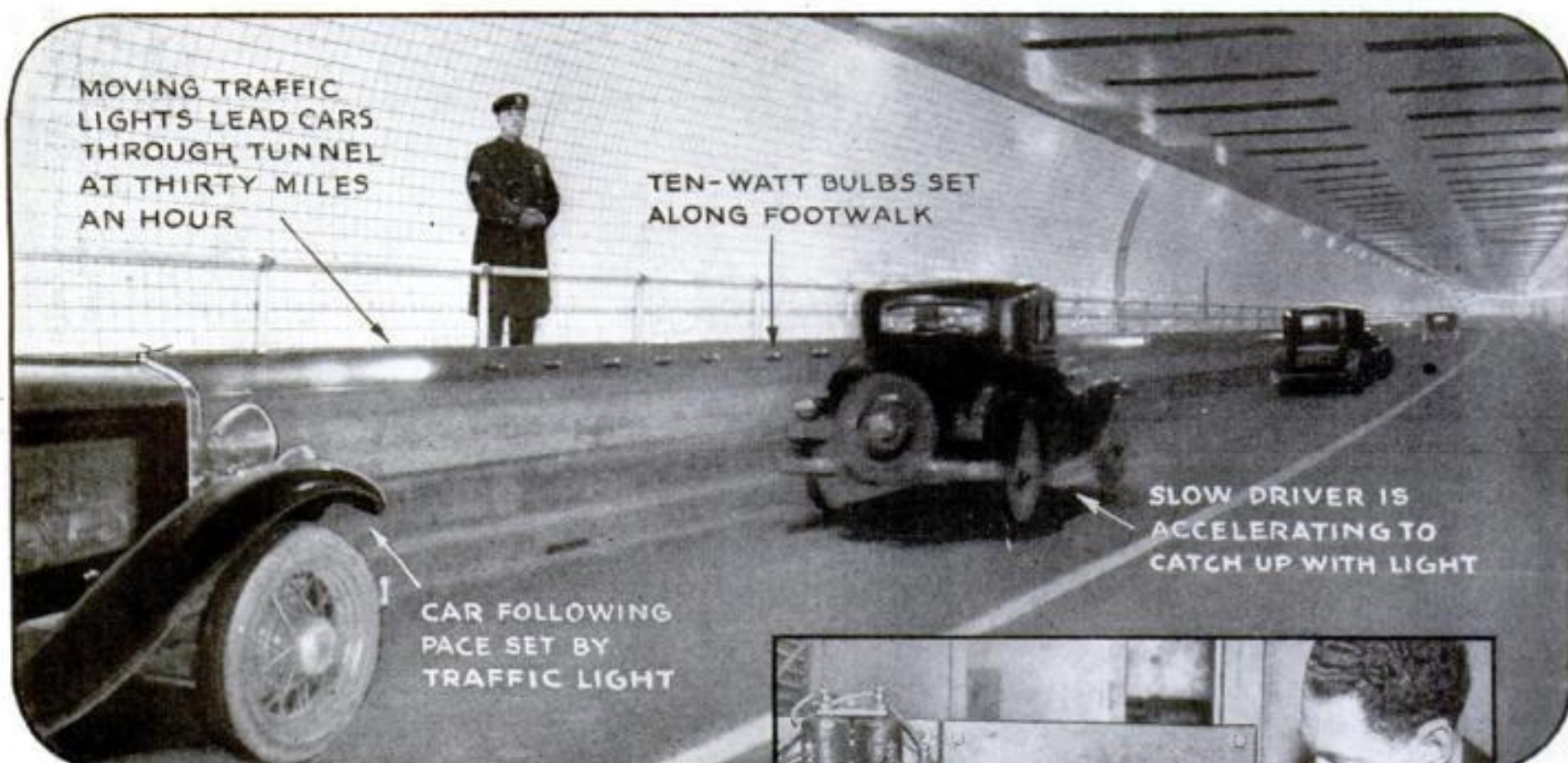
The man shook his head in a violent negative. Taking his hand away, Chief Murray said:

"That's right. If you can breathe when that hole is covered your mask is leaking. Always test it that way before you enter smoke- or gas-filled premises."

I asked one of the volunteers what was the need for which they chiefly anticipated the use of gas masks. He pointed toward the stables of Belmont Park.

"Some night," he said solemnly, "we may have to (Continued on page 122)

Racing Lights in Tunnel Urge Car Drivers to Greater Speed



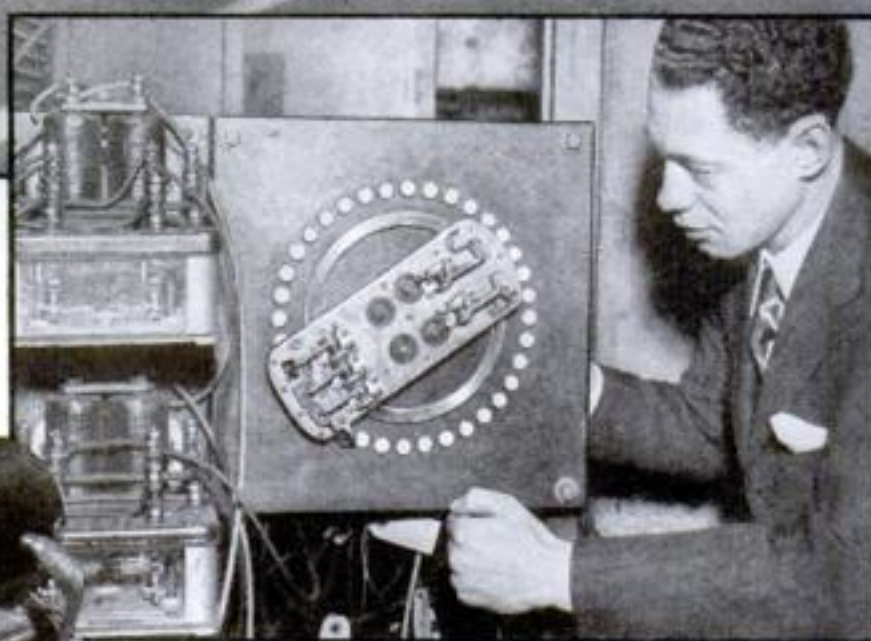
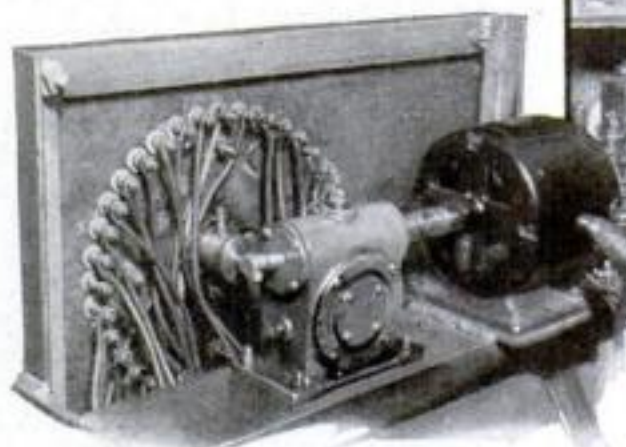
Panoramic view of moving lights in Holland Tunnel, which race along the wall at thirty miles an hour and urge drivers to keep abreast of them, thus hastening traffic and preventing jams

Moving traffic lights, probably the first of their kind in the world, have just been installed experimentally in the Holland Tunnel between New Jersey and New York. Unlike ordinary traffic signals, they are designed to speed up passing drivers, replacing the frantic gestures of tunnel policemen.

Because this vehicular tube beneath the Hudson River has become more and more frequently choked with traffic, the odd scheme was decided upon in an effort to increase its capacity. Tunnel engineers installed a 1,000-foot row of ten-watt bulbs along the footwalk on the New York-bound side of the tunnel for the tests. They also designed and built a control system similar to that used in animated electric signs.

A motorist entering the tunnel during rush hours sees a yellowish flash of light racing along the wall beside him, like the flaming tail of a comet. It is traveling at thirty miles an hour, and he is expected to keep up with it. Seventy-five feet ahead of him, and behind, similar lights guide other drivers. Thus they stimulate laggards, admonish speeders, and also aid in keeping cars the legal distance apart in the tunnel.

Officials are reserving their plans for completing the system until further tests, but it is said to have worked with encouraging success. At this writing it was planned to distribute cards to patrons of the tunnel, explaining the purpose of the lights. A woman driver, frightened by the new lights, crossed the center line of the double-lane tube in defiance of regulations. Questioned by the police, she explained that she thought the tunnel was on fire.



Above, front view of mechanism that controls operation of the moving lights on the principle of animated electric signs. Left, rear view of apparatus that lights lamps in quick succession

ELECTRIC VOTE ON PICTURE IS SECRET

So THAT its members need not express their opinions out loud, a Detroit, Mich., jury of artists is using electric buttons to ballot on contributions to be hung in a Michigan exhibition of paintings. When they have voted "yes" or "no" on a picture shown to them a score-keeper announces the total vote, but each member's private decision remains

secret. The picture is accepted if a majority has indicated its approval. Since the deciding votes are anonymous, the picture is more likely to receive an impartial verdict entirely on its merits.



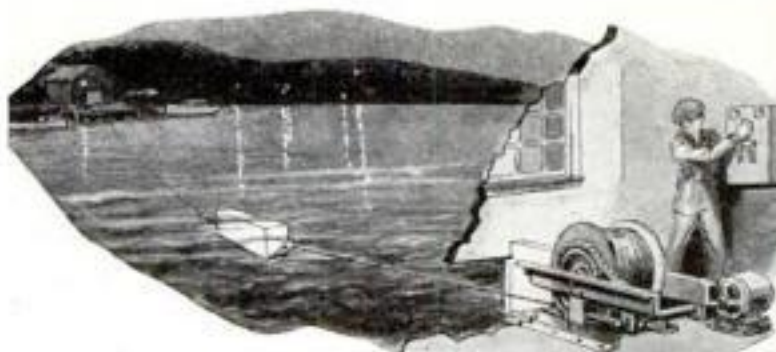
With electric push buttons, jury members vote in secret on merits of picture

UNDERWATER CABLE BRINGS IN BOOZE



RUMBLE OF VOLCANO SENT OUT BY RADIO

TO THE variety of noises that have been broadcast by radio must now be added the rumble of a volcano in eruption. During the recent activity of Hawaii's famous volcano Kilauea, engineers crept to the edge of the crater and suspended a microphone over the boiling lava in the pit. The angry mutterings were radioed to the United States and re-broadcast for the benefit of American radio listeners. The picture shown here was snapped by a photographer just as the engineers were setting their microphone in place beside the perilous cliff. The "mike" was padded to protect it during the climb.



Drawing, upper left, shows how liquor was smuggled into America under water. Above, motor-driven windlass that ran the cable



Left, two of the torpedoes which, filled with booze, was dragged by cable across Detroit River

WHEN Federal agents investigated mysterious ripples seen by moonlight near the shore of the Detroit River, where it separates Grosse Point, Mich., from Canada, they found one of the most ingenious rum-smuggling devices yet disclosed. Bootleggers had rigged up an underwater cableway to haul submarine "torpedoes," filled with

bottled liquor, across the river to the American side. A motor-driven windlass reeled in the mile-long cable at a fast clip. According to agents, this apparatus could run forty cases of liquor an hour past unsuspecting customs guards. When the boat-house terminal was raided, a cargo was in transit, but the operators had fled.

TINY CAR, STREAMLINED, PROVES FAST

A TINY streamlined car with only three wheels, invented by a Garden City, N. Y., airplane manufacturer, is said to have attained a speed of eighty-five miles an hour in recent secret tests. At rear of the oddly-shaped car is its four-cylinder motor, developing thirty-four horsepower. A high-speed auto truck for light delivery has been

constructed by the same builder along similar lines. The inventor, Capt. James V. Martin, produced another remarkable mid-get car two years ago (P.S.M., Oct. '29, p. 25) to be delivered in a packing box that would also serve as its garage.



KNOB SPINS CAR WHEEL

A NEW attachment for an automobile's steering wheel, in the form of a pivoted knob, makes it easy to spin the wheel with one hand for a sharp turn. The driver's other hand is left free for signaling. According to the maker, it also affords a more restful grip on the wheel in ordinary driving during a long trip.

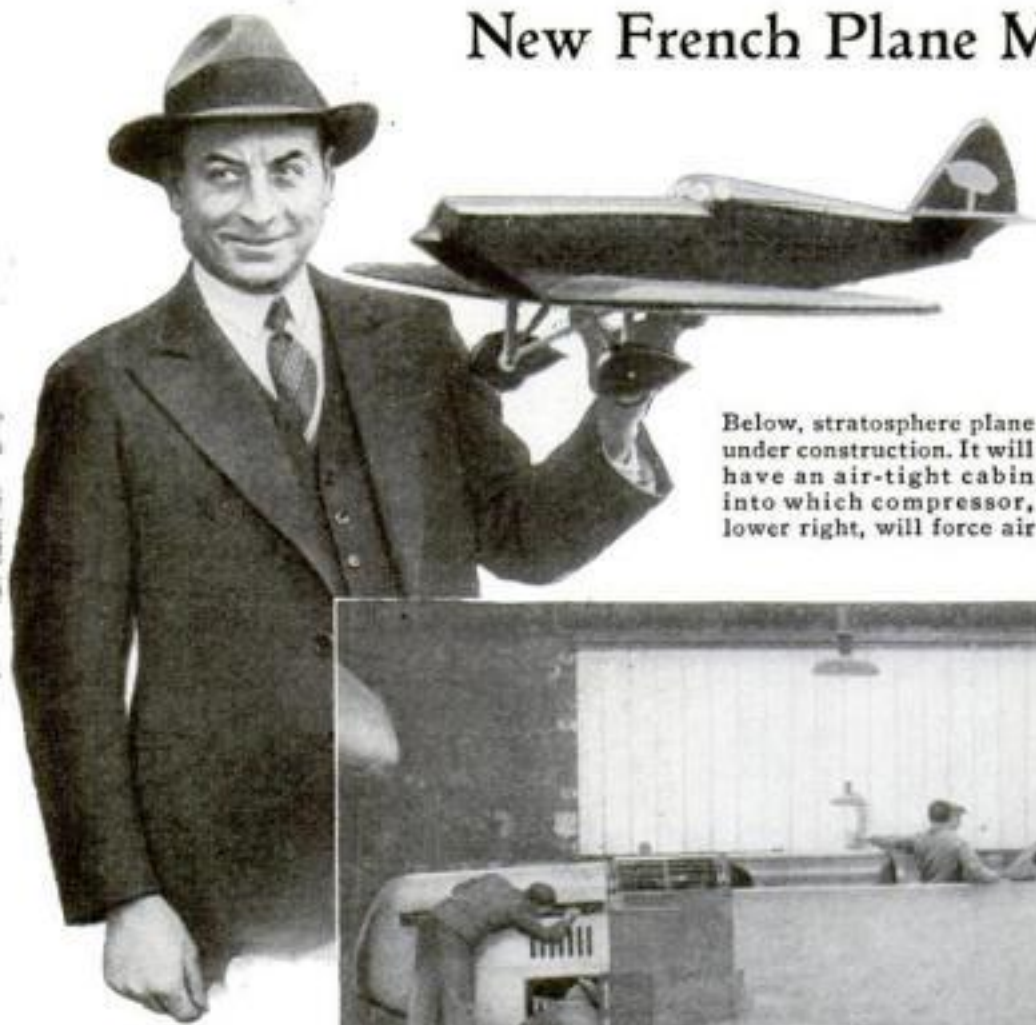
RADIO TRAPS CROOKS

How effective an instrument radio provides for reducing crime is shown by a recent analysis of arrests in Chicago during 1931. In this one city, figures show the police radio system led to the arrest of 6,000 criminals in the year.



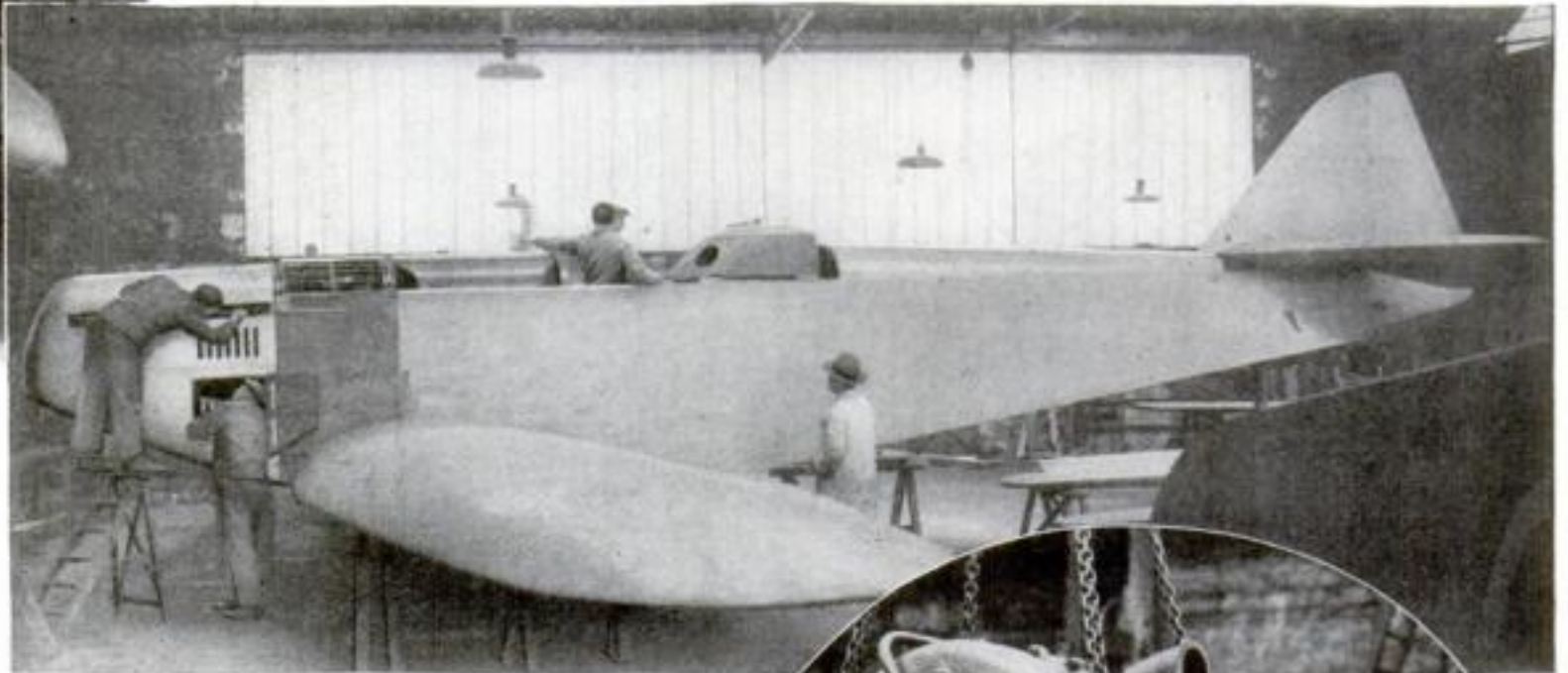
Streamlined and with motor in the rear, this tiny car goes 85 miles an hour

New French Plane May Fly at Ten-Mile Altitude



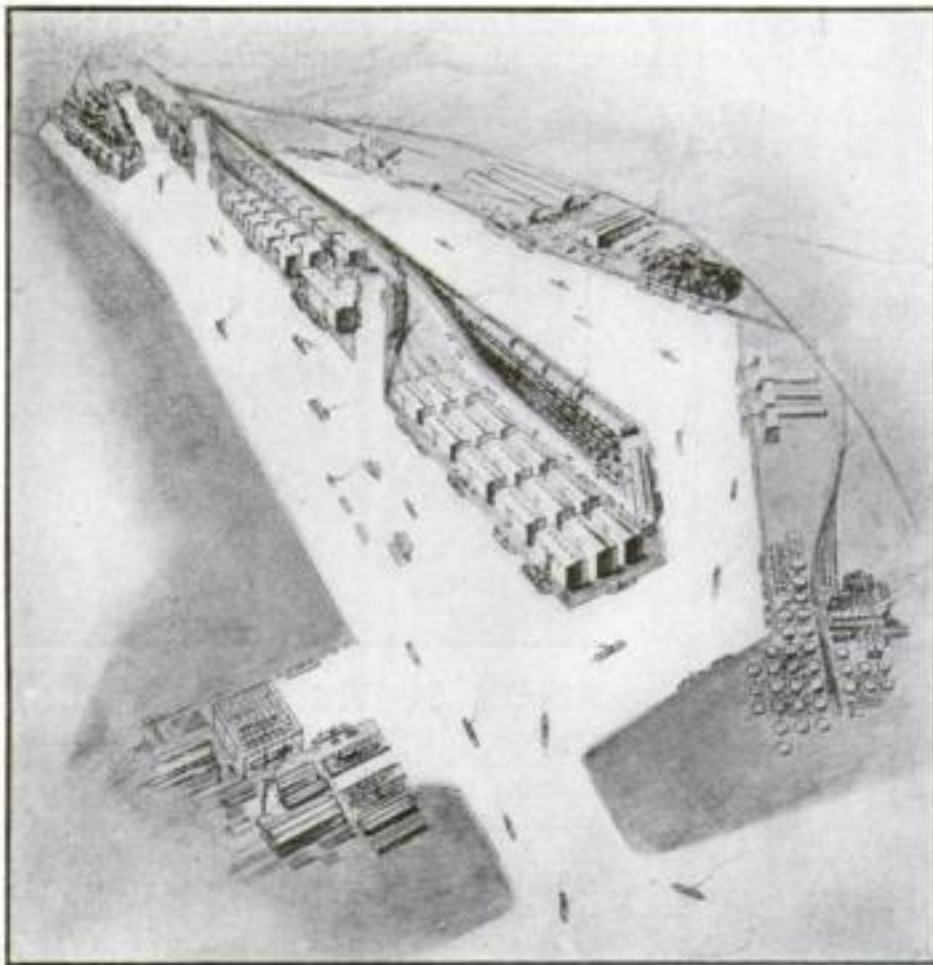
Above, French inventor exhibiting model of new plane he expects to fly at 10-mile level

Below, stratosphere plane under construction. It will have an air-tight cabin into which compressor, lower right, will force air

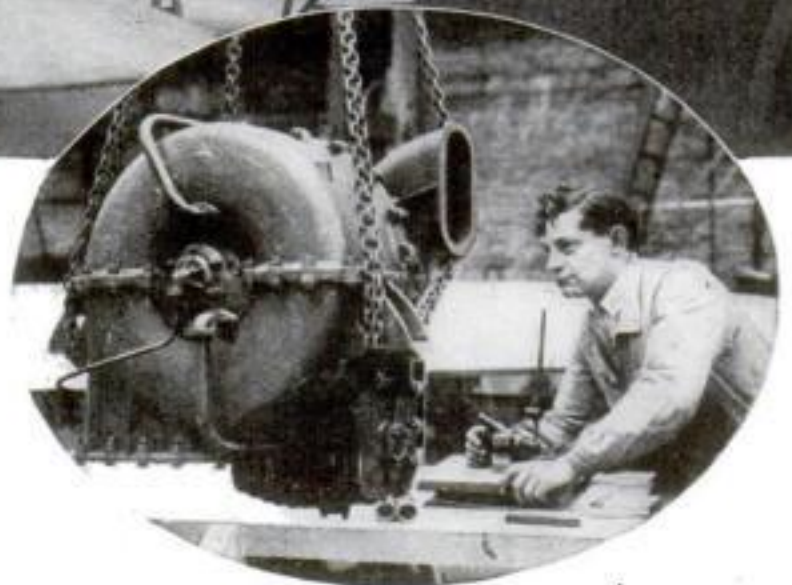


WHILE nations race to put their first high-speed airplanes in the stratosphere, or upper story of the earth's air, a new contender is reported under construction in France. Its designer, a French engineer named Guerchais, expects it to be able to climb to a height of ten miles within forty minutes. It will then be able, he says, to fly at 250 miles an hour because of the thinness of the upper air. For the same reason the passenger cabin will be sealed air-tight and a large compressor will pump air into it to maintain a normal pressure for comfortable breathing. Another stratosphere plane is awaiting its first trials at the Farman factory in France, while Germany's first plane of this type recently made a test flight at low altitude (P.S.M., Jan. '32, p. 56).

PLAN ARTIFICIAL OCEAN PORT



A 2,000-ACRE artificial port for Rhode Island, in which the largest transatlantic liners could dock, is proposed by two Rhode Island financiers and a world authority on port engineering. The project would provide fifteen miles of docks and would cost \$5,000,000. Part of the plan is to obtain legislation from Congress designating this an "open port," the only one of its kind in the United States, where goods might be unloaded without passing through customs or paying duty until a buyer is found. Point Judith, the site chosen, is 250 nautical miles nearer Liverpool than is New York.

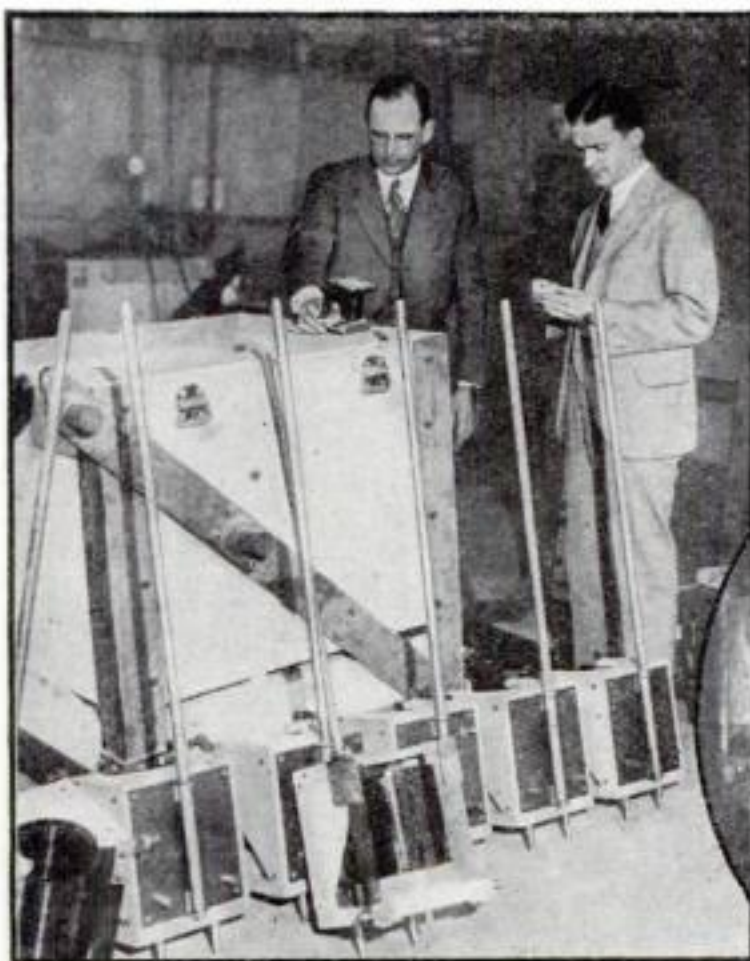


RADIO FEVER MACHINE

RADIO fever machines, that cause an artificial fever to aid in combating certain diseases, are in hospital use. Now comes a new adaptation of the device, designed for local treatments. Two plates apply the heat. Like its larger counterpart, the new apparatus works on the principle of a short-wave radio transmitter.



Rocks Turn to Vapor in the World's Hottest Furnace



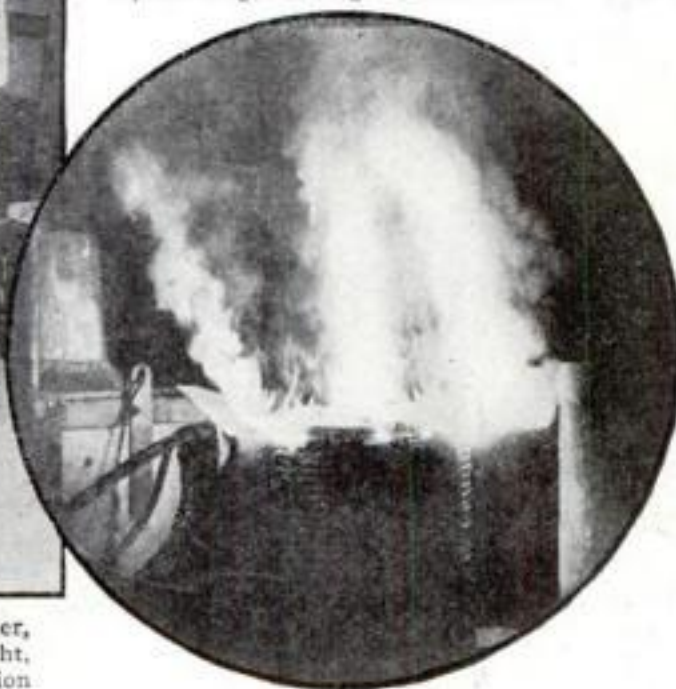
Above, the new 6,000-degree furnace with its designer, Frank T. Chestnut, right, of Trenton, N. J. At right, striking picture of the hottest furnace when in action

ENGINEERS recently witnessed at Trenton, N. J., a demonstration of the world's hottest furnace for practical commercial use. Within a chamber a cubic foot in size, it maintained electrically a temperature of 5,400 degrees Fahrenheit—comparable to the searing tip of an oxy-acetylene blowtorch, and nearly 2,000 degrees higher than ever

before attained with such close control. Even 6,000-degree temperatures were obtained for brief periods.

Startling things happened when goggled engineers dropped samples of materials through the furnace's venthole. A chip of wood puffed instantaneously into gas, and disappeared with a flash of flame. Rocks of magnesium or silicon base were torn apart, and vapors shot out, burning with the dazzling white flame of magnesium flash powders and silicon. Iron and graphite reacted violently together with a roaring blue and white flame. When the power was on too long, the force of this reaction blew up the furnace, and it was rebuilt.

Essentially the furnace is a graphite crucible enclosed in extremely effective heat insulation, and surrounded by an electric coil carrying powerful high-frequency currents. These induce a corresponding current in the crucible itself and heat it to incandescence. At present the temperature is limited only by that at which the graphite vaporizes—more than 6,000 degrees. By enclosing the furnace under pressure in a cylinder or sphere, engineers believe higher temperatures may be attained.



RACING BOAT WEIGHS 22 POUNDS

A MARVEL of lightness is a rowing shell constructed by a German athletic instructor. Although measuring twenty-six feet in length, it is said to weigh but twenty-two pounds. It may easily be held upright with one arm, as demonstrated in the photograph. No nails or screws of any kind were used in the construction of the odd craft.



This racing shell is twenty-six feet long but weighs only twenty-two pounds

NEW FILM TAKES PICTURES IN COLOR

SNAPSHOTS in natural colors, the dream of amateur photographers for many years, are now made possible with an ordinary hand camera through the use of a new roll film, just placed on the market. Put in the camera in the usual way, no special equipment is needed for using this film except a small plate that keeps it flat in the camera. The film requires only about three times normal exposure. After the pictures are taken, the roll is sent to the manufacturer's laboratories, where the finished prints in colors are made on paper; with duplicates, if desired.

The roll is now supplied in the widely-used $2\frac{1}{2} \times 4\frac{1}{4}$ size, and others may soon be made available. Instead of the usual single strip of sensitized film the roll contains three strips, one to record each



A three-strip film with which snapshots can be taken so that natural colors can be reproduced

of three primary colors. The nearest one to the camera lens is stained yellow to serve as a filter and thus equalize the effective speed of each film. Since the strips are held firmly together, the image is impressed through the translucent back of each upon the succeeding one. The result is three black-and-white negatives, each with patches outlining areas of the particular color to which it is sensitive. Enlargements are made from the negatives, and are used to print the finished picture on paper with colored dyes.

ICE CUBES UNMELTED BY FIRE THAT SWEEPS HOME

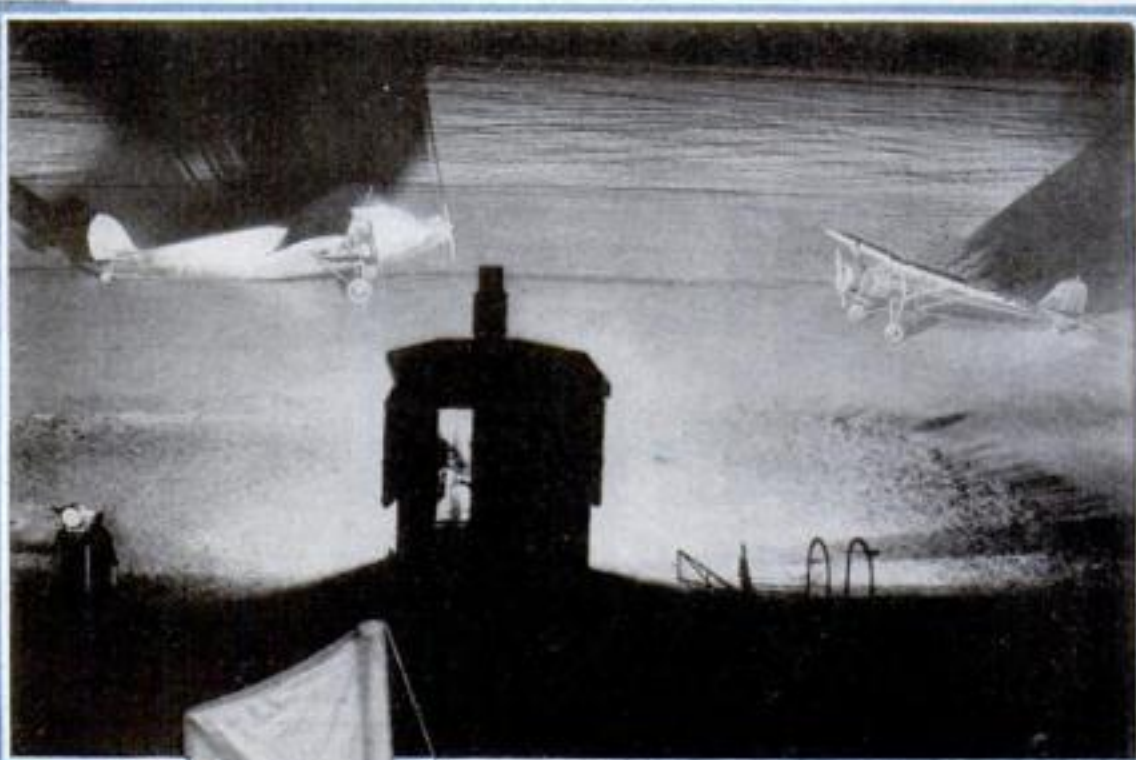
WHEN fire swept through a ten-family apartment house in Cleveland, O., not long ago, its electric refrigerators received a test that the manufacturer never thought of. Engineers found, several hours later, that although the outsides of some of the refrigerators were scorched black the ice cubes within them had not melted.



PHOTOS SHOW
Latest Events
in Aviation



BIGGEST VERTICAL WIND TUNNEL. Akron, Ohio, now has the biggest vertical wind tunnel in the world and the only one in this country. Built in the shape of the letter "C," it is sixty feet long and a powerful motor will drive a blast of air through it at 125 miles an hour. Photo shows the tunnel being lowered into the building housing it.



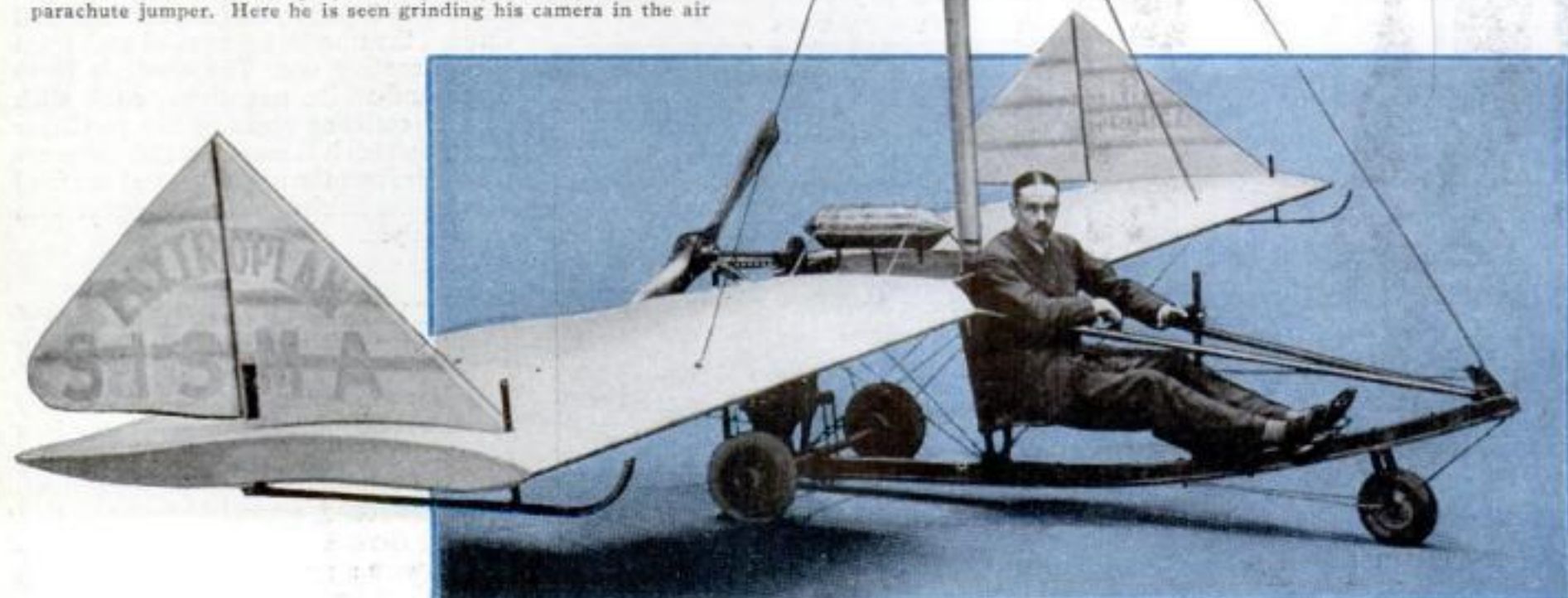
TAKES THE TERROR OUT OF THE NIGHT. Pilots no longer dread night landings at the Camden, N. J., airport. A 5,000,000-candlepower floodlight, recently installed there, throws its white light into the darkness and brings the glare of high noon to the air field.



A PERILOUS PERCH FOR A CAMERAMAN. Strapped on top of a plane just in front of the tail, this daring photographer took his camera aloft for the purpose of getting action pictures of a parachute jumper. Here he is seen grinding his camera in the air.

SOMETHING NEW FOR FLYING

Below, Vicomte de Rouge, a French engineer and inventor, seated in his strange tailless plane. Opening the hexagonal control on the mast directs the plane upward and closing it guides it down. The rudders on the wing tips are used to steer the queer craft.





ROCKET RISES SIX MILES

At left, a rocket, designed by Reinhold Tilling, German experimenter, set a new altitude record when it reached an estimated height of six miles. It was returned to earth by attached parachute without harm

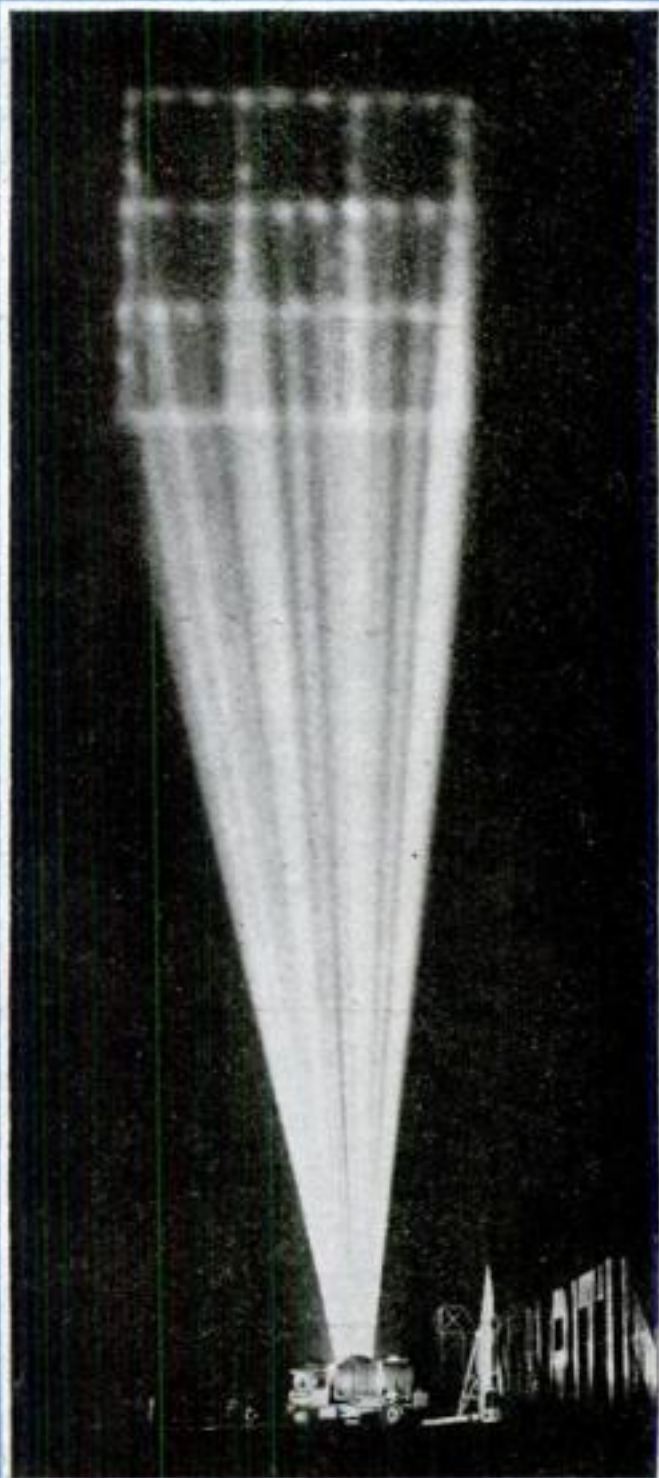
WINGS STEER BALLOON

In Greece recently a new type of balloon was tried out. Attached to it was the apparatus seen near the ground, which is a pair of wings to steer it



RADIO COMPASS FOR FLYERS

At left, Warren S. Eaton, aeronautical engineer, with the automatic compass for planes he has just invented. The new instrument gives direction, elevation, and map position, and its inventor says it makes blind flying possible. It is operated by tuning to station, which holds the needle steady

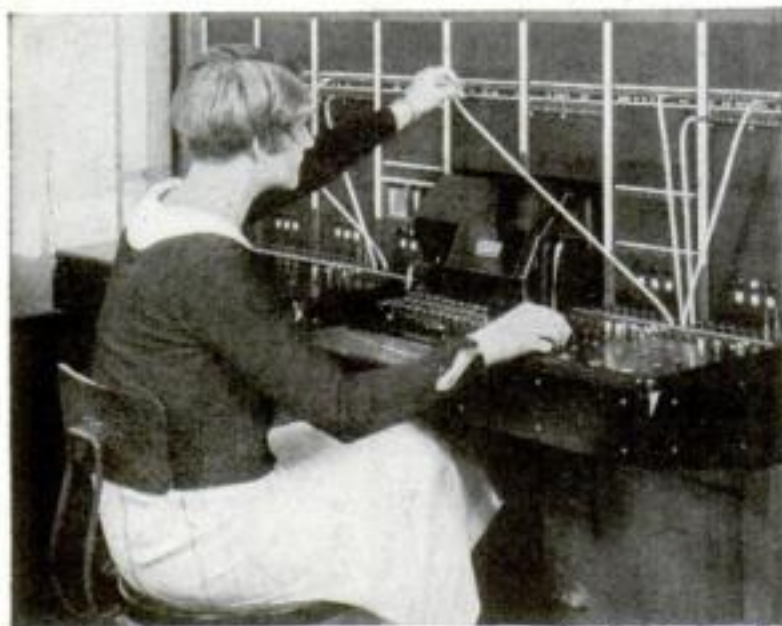


SEARCHLIGHT THROWS GRID ON SKY TO TRAP ENEMY PLANES



Major Jack Savage of London has produced an anti-aircraft searchlight, two pictures of which are shown at the left. The strange light paints upon the sky a grid by means of which the speed of an enemy plane can be gaged so that gunners can train their weapons more accurately upon it. The dazzling grid of light gives not only the speed of the plane but also its elevation and direction of flight. The picture at far left shows the grid thrown upon the sky, while the one at its right shows the light being operated by its inventor, who was also the inventor of the art of skywriting

Teletype Users Now Have "Central" and Directory



A HISTORIC document has just come from the press—a small brown pamphlet of thirty-two pages with a title, "Teletype Directory," that marks it as comparable in importance to the world's first telephone book. It signals the recent interconnecting of more than 1,100 users of teletype machines of the Bell system in a single network, so that any subscriber in the United States may call up another on his keyboard and carry on a two-way "conversation." News bureaus, banks, detective agencies and other business enterprises with many branches are using this new service.

A teletype machine is a typewriter hooked up electrically to run in unison with another which may be many miles away. Whatever message is typed on one will appear automatically, with a clicking of keys, on a sheet of paper in the other. Hitherto, teletypes have been installed only in point-to-point systems—as between two distant offices of the same firm. Now all messages will pass through a "Central." Nearly 150 such central offices

have been established for the purpose.

To call any subscriber in the directory, in which names are listed alphabetically under towns and cities, a subscriber types its call characters upon his teletype. These consist of the name of the city or its code letters (such as "PHLA" for Philadelphia), followed by several numbers indicating the particular station called. Central sees the call appear on a teletype machine in front of her, and connects the caller directly with the desired party. The two may then hold a two-way conversation in writing. Permanent records are preserved at each end of the wire, and may be filed for reference, while extra carbon copies may be made at the desire of either party.

Calls are charged for, like telephone calls, on the basis of elapsed time and

Below, a teletype subscriber typing a call to central for distant party



At left, the central teletype girl who puts through the call. Above, pages in first teletype directory

distance; the "local" rate is twenty cents for five minutes. A new edition of the directory will be issued each month for the first few months.

A somewhat similar service has also been announced by the Western Union and Postal Telegraph companies, linking nearly 10,000 users of their own telegraph printers in a one-way conversation system. Here the subscriber transmits his entire message to "Central," and awaits a reply. At the central office, the message is retransmitted by a perforated tape to another "Central" and thence by telegraph printer to the proper party. This type of service is adapted to the needs of a user whose messages customarily require consideration or an analysis of figures, for example, before reply, and where a running conversation is not desired.



METAL CONE AND CANDLE KEEP TREES WARM

YOUNG orchard trees are nursed safely through a spell of freezing weather by a novel type of "incubator." A cone of sheet metal surrounds the tree, and the air inside is warmed by a lighted candle inserted through a door. Since little heat escapes, this method is economical and offers ample protection to the tree in even the coldest weather.

HEAT CHANGED INTO ELECTRICITY

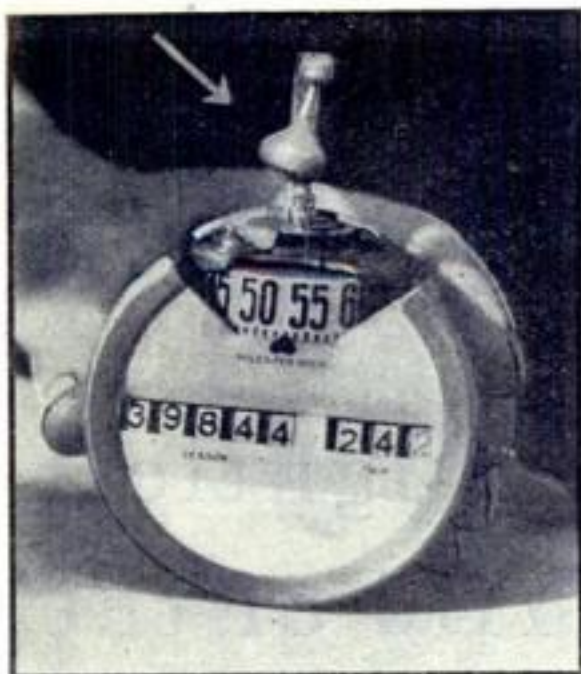
ONE of these days you may run your radio set on gasoline—and boast about how many hours you get to the gallon! A device to convert heat directly into electricity in sufficient quantities to operate a standard radio receiver has just been demonstrated by a St. Louis, Mo., inventor.

Burning gasoline or kerosene, the set is intended for use in homes where a regular electric supply is not available. According to the inventor, a gallon of "gas" will operate a radio set using the new two-volt tubes for 160 hours. Electricity is generated by heating the jointed surfaces of dissimilar metals, a phenomenon well known to science as "thermo-electricity."

Hitherto this principle has remained a laboratory toy, except in delicate instruments such as pyrometers for measuring high temperatures. But the inventor of the thermal current-generator declares that new, secret alloys he has discovered open an economical way to produce electricity for radios, and possibly even for power on a larger scale.



Running radio set on gas. The device in foreground is said to turn heat into electricity



REGISTERS CAR'S SPEED AT TIME OF COLLISION

A TELLTALE device called a "striko-meter" has been invented by a California garage owner to serve as a silent but irrefutable witness in automobile accident cases. Inclosed in a tamper-proof housing, it would reveal at just what speed a motorist was driving when his car was involved in a crash. The device resembles a standard speedometer in appearance, but any sudden impact swings a pendulum within the instrument, releasing a spring-operated needle that locks the speedometer dial at whatever speed is indicated at the moment. It cannot then be reset until the case is unlocked by a police official or other person with the manufacturer's master key, and its evidence will automatically convict a driver who has been traveling at reckless speed. If motorists were compelled by law to use such an instrument, the inventor maintains, there would be no grounds for argument in auto accident damage suits. His invention followed an accident in which his partner was seriously injured and his car wrecked by collision with another machine.



Synthetic rubber, made of acetylene from coal and limestone, stretches like real thing

WORLD WAR NORTH SEA MINE EXPLODES



At right, returning a World War mine to the North Sea after attaching a detonating fuse. Above, such a mine exploded by a fuse

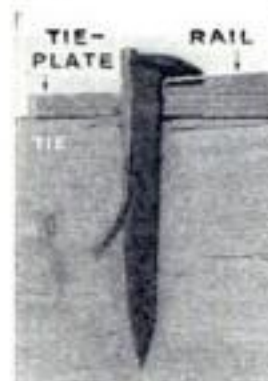


THOUGH more than thirteen years have passed since the World War ended, fishermen of the North Sea still are menaced by stray floating mines. Whenever one is sighted and reported, it is gingerly hauled from the water by a government vessel and a detonating fuse attached. Then the explosive mass is lowered carefully back into the sea and watched from a safe distance until it explodes with a terrific concussion, throwing a column of spray hundreds of feet in the air. Such a scene is shown in the striking photographs reproduced here.

COAL USED IN MAKING SYNTHETIC RUBBER

WITHIN a few months, production of synthetic rubber is scheduled to begin at the Du Pont plant at Wilmington, Del. This strange product looks like natural rubber, stretches in the same way, and is believed applicable to an enormous number of purposes where natural rubber is now used. The primary raw material is acetylene gas, obtained from coal and limestone. The first step in the process was discovered by Father J. A. Nieuwland, working with acetylene in a laboratory of Notre Dame University.

PIN LOCKS THIS SPIKE



Railway spike with a turned-out locking pin

A RAILWAY spike that is declared to hold firmly for the life of the tie into which it is driven has been designed by a Fargo, N. D., inventor. The back of the spike has a rounded shoulder, and a locking pin forced home against this shoulder is turned outward into the tie.

prints

. Mightiest Aid of the Manhunters



An enlarged picture of a fingerprint showing the distinctive features, some form of which is on every hand in the world

CROUCHING low over the wheel of a speeding car, a highway bandit streaked south from Seattle, Wash., not long ago, his companion blazing away in a running gunfight with half a dozen deputy sheriffs. Ten miles from town, the battle ended. One deputy had been killed and the outlaws had twisted away from their pursuers and disappeared.

Late that night, a farmer reported finding an abandoned automobile, with a dead man in it, on a lonely mountain road. Officers identified the bandit car. Slumped in the back seat was one of the wanted men, a bullet fired at close range in his right temple and a revolver clutched in his stiffened fingers.

This gun, together with the fatal bullets recovered from the bodies of the deputy and the bandit, were taken to Luke S. May, at his famous scientific crime detection laboratory, on Twelfth Street, Seattle. He examined both missiles. They had come from the weapon found in the dead man's hand. The highwayman had evidently killed the deputy and later committed suicide. But May was puzzled. His understanding of criminal psychology told him that bandits don't commit suicide after a getaway.

Carefully spreading white clay powder over the recovered weapon, he brought out the fingerprints on it. The result was a perfect "Who's Who" of the sheriff's posse! Thirty people had handled the gun before it was submitted to May. This jumble destroyed whatever evidence there might have been on the outside of the gun when it was taken from the abandoned car.

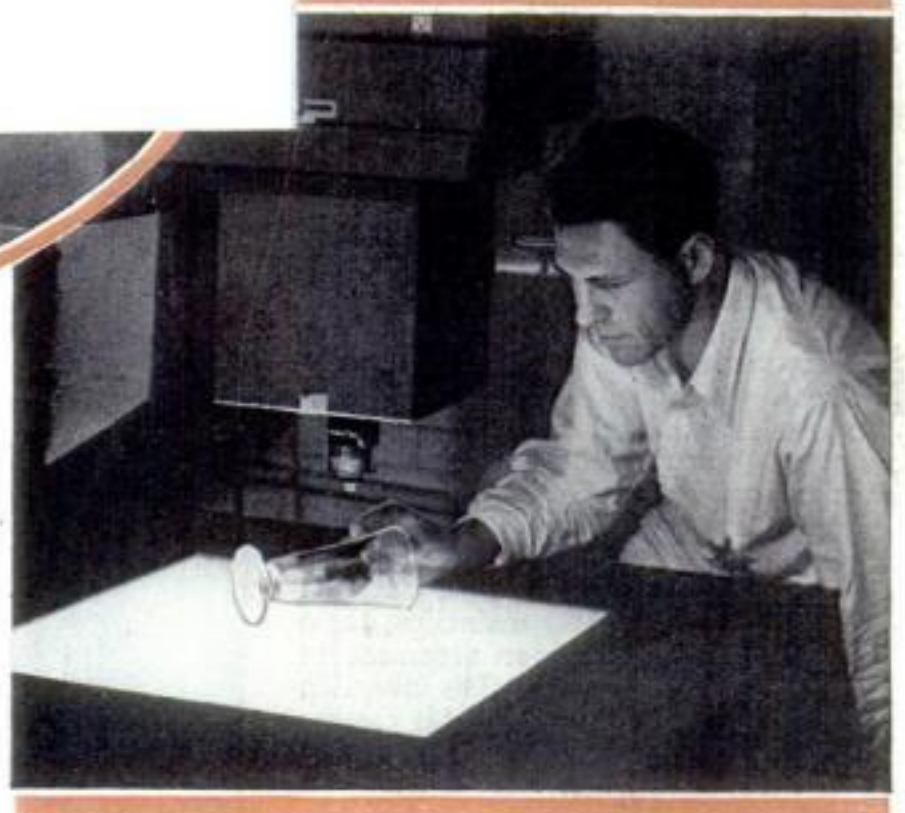
A few days later, the second highwayman was brought in. May showed him the revolver.

"I never touched that gun in my life," he declared. "It belonged to my pal."

That ready reply sent him to the gallows. The next day, as May studied the weapon, he noticed that the slightest pull on the trigger let the hammer fall. Taking the gun apart, he found that the owner had filed down the trigger notch to give the weapon a lighter pull. More than that, he found, all over the inside of the gun, *the fingerprints of the second bandit!*

Realizing that the death of the officer would keep the police implacably on his trail and that an attempt would be made to trace the fatal bullet to the gun that fired it, he had treacherously murdered his confederate and placed his own revolver in his hand to give the impression of suicide. The sinister plot had all but succeeded. Then, the faint imprint of the pattern left by the ridges of the gangster's fingers broke down his cold-blooded scheme and forced a confession from him.

OF ALL the phases of scientific criminal-catching, fingerprinting probably has the greatest number of thrilling captures to its credit. In New York, in Chicago, in Washington, D. C., I have talked to experts who have tracked down



Latent fingerprints on this water glass will be visible when Bernard Ginn, photographer of Los Angeles County Identification Bureau, has completed photo he is preparing to take

wanted men through the mysterious loops and whorls, arches and islands, that appear in ever-varying patterns on individual fingers. The nerve tingling feats of such scientific Sherlocks make headline news throughout the world.

Practically every police department in America is now equipped for fingerprint work. At the New York City headquarters, I was shown files containing more than a million separate prints. In Washington, D. C., the "fingerprint clearing house," maintained by the Department of Justice, is growing at the rate of nearly half a million prints a year. This great crime-fighting machine, with its trained experts, its army of clerks, its battery of typewriters, pounding out answers to nearly 2,000 queries a day, is unifying the police of the nation in a scientific offensive against the underworld.

One of the most brilliant bits of fingerprint work in recent years was accomplished a few months ago by Albert Ground, one of the classifiers in the department.

A Dramatic Explanation of How Tiny Lines Are Now Used to Convict Desperate Crooks

By EDWIN W. TEALE



Left, New York City expert using electrically lighted camera to photograph fingerprints. On the floor is machine for blowing powder over the safe. Above, a special enlarging and lighting device, held in place by headband, is used in the study of prints



Left, a fingerprint magnifier with a disk marked with concentric circles. Above, a print seen through the disk. Position of ridges on circle is basis of identification by this English system

tives found a single clue—the bloody thumb-print of one of the assassins.

Eventually, this print was forwarded to Washington. It matched none of the millions on file. But Ground noticed its peculiar pattern. Fourteen months went by, with from 6,000 to 10,000 fingerprints a day passing over Ground's desk. Then, police at Stockton, Calif., forwarded the prints of a known criminal. Instantly, Ground recognized the pattern of the thumb-mark, looked up the old print, compared it, and found it identical. By remembering

this single fingerprint fourteen months, he not only brought about the death of the four murderers, but released four innocent men who had been wrongly identified as the slayers by nearly sixty people.

For international use, a code has been worked out that enables an expert to send a fingerprint description by radio or cable to all parts of the world. Not long ago, such symbols bridged the 7,500-mile gap between a Berlin, Germany, radio station and Buenos Aires, Argentina, resulting in the capture of an international confidence man. By teletype, the actual pictures of fingerprints are now flashed between distant cities, and hardly a mail plane flies east or west today without

carrying in its pouches fingerprint copies vital to the apprehension of criminals.

So rapid and widespread has been the adoption of fingerprinting that few people realize that it has been in use for only thirty years. As early as 200 B.C., Chinese emperors signed official documents with their thumb-prints, but it was not until the nineteenth century that scientists gave serious study to the subject. After years of research, Sir Francis Galton, cousin of the great naturalist, Charles Darwin, published a book in 1892, showing that all fingerprints are different. Then, in 1901, Sir Edward R. Henry, head of the London police, established at Scotland Yard the system of criminal identification now used throughout the world.

GLANCE at the ball of your thumb or fingers and you will notice that the ridges swirl about in a definite pattern. You are the only person on earth with that exact ridge formation. Faces may look alike, bodily measurements may duplicate, names may be identical, but the lines and loops on every hand, experts say, form an individual pattern that has no counterpart. Take the classic case of the two Will Wests.

In 1903, a negro by that name entered the Federal penitentiary at Leavenworth, Kans. As he was being photographed and his measurements taken, the record clerk thought he recognized the face. He compared the measurements just made with his files and found they were exactly the same as those in an envelope marked: "Will West." A photograph in the envelope showed the identical features of the new prisoner.

"That's me, all right," the amazed negro admitted when he saw the likeness, "but I don't see where you got my picture, because I've never been here before."

Investigation showed that another negro with the same name, the same fea-

On the afternoon of May 23, 1928, four strangers stepped from a motor car and walked swiftly through the doors of the First National Bank, at Lamar, Colo. Whipping out revolvers, they killed two guards before they could move a muscle, rushed to the big safe, gathered up \$200,000 in cash, and made their getaway through a rain of bullets.

Across the Kansas line, at Dighton, late that night, a doctor was called from his bed to treat a stranger, one of the gang who had been shot during the escape. As he rose from dressing the wound, the members of the vicious gang riddled him with bullets, threw his body over a cliff, and pushed his automobile after it. On one fender of this wrecked machine, detec-

tures, and the same bodily measurements was still serving a life sentence in the same penitentiary for a murder committed in 1901. When fingerprinting was later introduced, officials took the thumb-prints of the two Will Wests. Even a layman, at first glance, could tell they were entirely different.

Imagine the number 1,000,000 followed by fifty-four ciphers! That staggering figure compared to one represents the chances of two fingerprints in this world being the same, according to the French authority, M. Balthazard. The prints that are the most alike are those of identical twins. In the case of two brothers, policemen in Berkeley, Calif., and the Ellis twins, who came to the notice of Scotland Yard in England, the patterns were at first declared identical. Under the microscope of the expert, however, differences appeared.

NOT only are fingerprints distinctive, but the patterns formed by these tiny nonskid ridges, that enable your fingers to turn the pages of this magazine without slipping, remain the same throughout life. Your hand may grow fatter or slimmer, but the patterns, like the design of a lace curtain, will stretch or contract but remain recognizably the same. A criminal may disguise himself in a dozen ways, grow a beard, and change his name—I was told of one character of the underworld who has had ninety aliases—but these telltale ridges and valleys will trip him up.

Criminals have attempted in many ways to mar their fingers so they would leave no fingerprints. One burglar seared his hand on a red-hot stove, a confidence man tried to shave off the ridges with a sharp razor, and gangsters have been known to try to destroy them by grinding with a pumice or applying acids. But in every case, I learned, unless the treatment penetrated deeply into the flesh, the ridges developed again, exactly as they had been before.

When the identification system was first introduced into America, one scoffing detective at the New York City headquarters submitted to a grueling test. After being fingerprinted, he placed his hand on a whirling grindstone until the tips of his fingers bled. Then, he was fingerprinted again. The faint lines of the ridges were still sufficient to identify the prints from among hundreds of others.

Not long ago, a fourth offender in New York made a desperate effort to beat the Baumes Law, which sentences such felons to life imprisonment. In the patrol wagon, after his arrest in an attempted holdup, he slashed the tips of his fingers with a bit of metal taken from the end of his shoelace, so his fingerprints could not be recognized. However, as soon as the superficial cuts healed, the ridges reappeared, giving infallible clue to his identity. While deep cuts destroy the ridges, they, themselves, aid in identification. For,



Fingerprint clearing house, Washington, D. C., where records are filed for instant use



Skin from finger tips of murdered man was mounted in this way and the victim identified

under a microscope, no two scars are ever alike.

With amazing accuracy, the markings of these practically indestructible ridges lead to the wanted criminal. A scientific sleuth, just returned from abroad, told me of one case in which a Scotland Yard detective found sixty different fingerprints on one bottle at the scene of a crime. After weeks of work, he traced fifty-nine of the sixty prints to reputable employees of the robbed store. But the one exception, the sixtieth print, led to the wanted man. When the famed Leonardo da Vinci painting, "Mona Lisa," was stolen from the Louvre, in Paris, some years ago, a single fingerprint on the frame resulted in the arrest of the daring thief.

A new method for accurately classifying single fingerprints has been devised by Chief Inspector Harry Battley, of Scotland Yard. He uses a round magnifying instrument having a plain glass window below, marked with concentric circles. The center of this transparent "target" is placed on a certain point of the print. Then the position of the various ridge lines in relation to the circles is compared to the position of similar lines on other prints until a perfect match is made. One California expert has calculated that if ten points on two prints are identical, the chances are 1,562,000 to one they were made by the same finger.

EVEN a fragment of an individual ridge pattern is often sufficient for a fingerprint specialist to identify the hand from which it came. A strange case, solved by what appeared to be partial prints, was related to me during my stay at the Scientific Crime Detection Laboratory,

in Chicago, Illinois.

As a climax of a number of mysterious robberies, a North Shore apartment was ransacked while the owners were attending the theater. The theory of the police was that the gang of elusive housebreakers employed a small boy to worm his way through the transom and unlock the door.

Fingerprint men examined the lintel carefully. They found a number of small markings, like fragments of fingerprints. Studying them at headquarters, they

made a remarkable discovery. The "fingerprints" were those of a small monkey. The gang had used the trained animal to enter apartments and open doors. With this clue, the police ran down the crooks and recovered most of the loot.

Often, the position of fingerprints on an object will give valuable aid in solving baffling crimes. In Los Angeles, a few months ago, the story of a suspect was broken down in this way by the silent evidence of fingerprints on a shotgun. They proved she had not merely picked up the weapon from the floor, as she said, but had held it to her shoulder in a position to shoot.

Again, a brutal murder on Long Island, N. Y., was cleared up by studying the position of fingerprints on a fatal piece of pipe used in the slaying of a physician's wife. The doctor told the police he had picked up the pipe from the floor beside his wife's body when he found her. But the microscope of the fingerprint men proved he had not just held it in his hands but had gripped it with great force, as one would in dealing a blow. His confession and conviction followed. In another instance, a man's story that he simply picked up a weapon after a killing was substantiated by the fact that his fingerprints *overlapped* others made by the actual killer.

MOST fingerprints studied by the scientific criminal-hunter are invisible to the naked eye until they are "developed" by the use of powders, inks, and chemical vapors. Along the tops of the friction ridges, which produce the lines in fingerprints, are rows of microscopic sweat pores. Through one of the powerful microscopes at the Chicago laboratory, I studied a ridge magnified a thousand times. It had the appearance, roughly, of a curving mountain range with a chain of volcanic craters along the top.

From these minute "craters" perspiration is constantly secreted, especially during times of excitement such as when a man commits an evil deed. In the chemical composition of perspiration, from one to one and a half percent is solid matter, mostly volatile fatty acids. This accumulation on the ridges leaves their shape stamped in invisible grease, an imprint that sometimes remains for years.

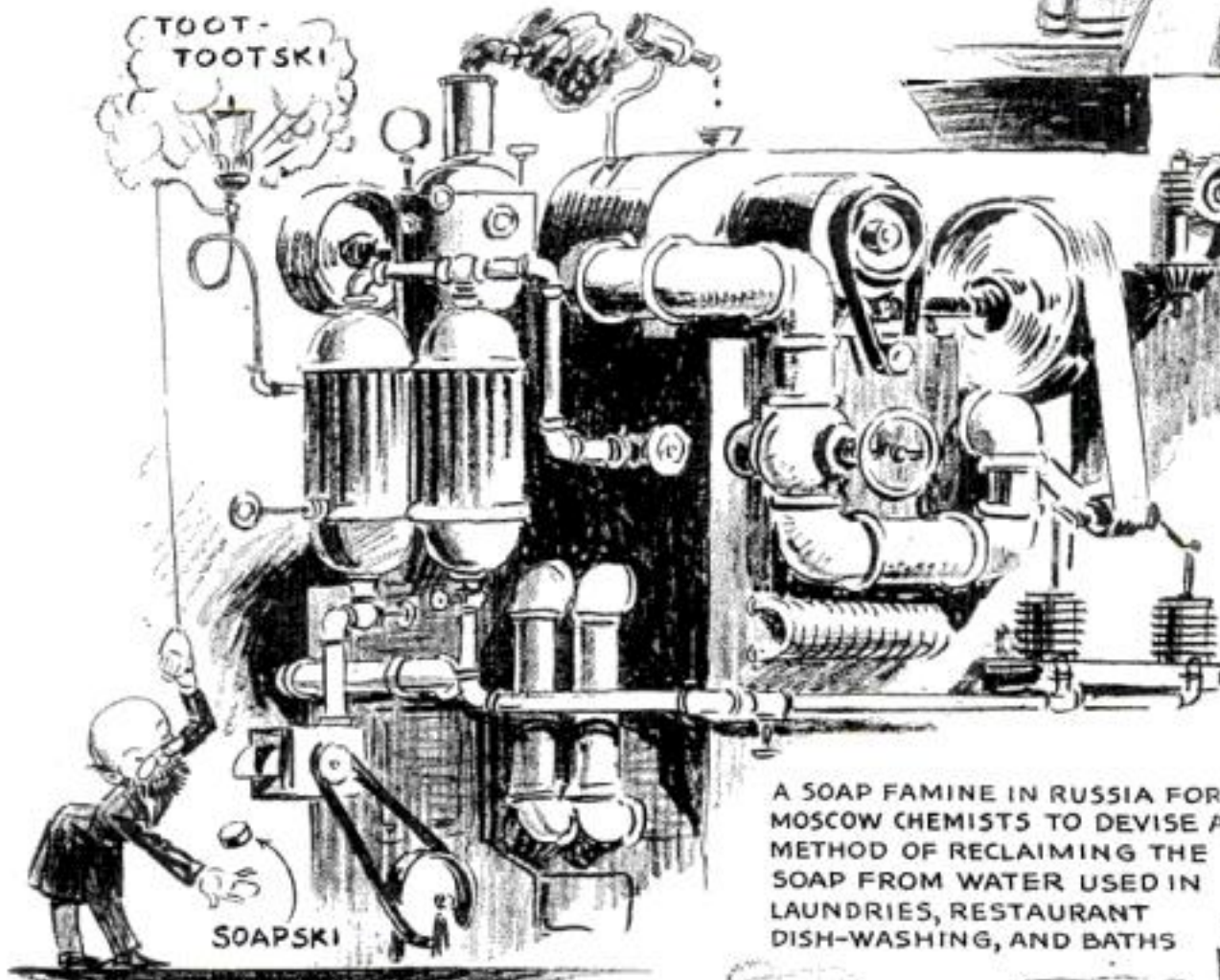
In Washington, I was told of a fingerprint on a forged *(Continued on page 134)*

SCIENTIFICKS

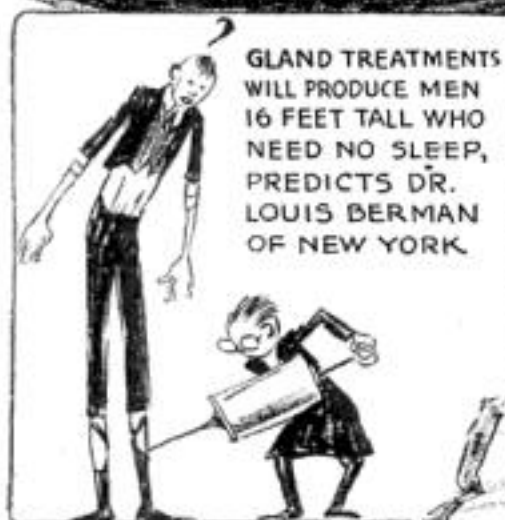
...OUR ARTIST VIEWS THE
STRANGE AND UNUSUAL FACTS DISCLOSED
BY LEADING AUTHORITIES IN THE LAST MONTH



SURGEON GENERAL CHAS. E. RIGGS, U.S.N.,
SUGGESTS NEW UNIFORMS FOR GOBS AS
PROTECTION FROM DANGERS OF TROPICS



A SOAP FAMINE IN RUSSIA FORCES
MOSCOW CHEMISTS TO DEVISE A
METHOD OF RECLAIMING THE
SOAP FROM WATER USED IN
LAUNDRIES, RESTAURANT
DISH-WASHING, AND BATHS



GLAND TREATMENTS
WILL PRODUCE MEN
16 FEET TALL WHO
NEED NO SLEEP,
PREDICTS DR.
LOUIS BERMAN
OF NEW YORK.



THE ANCIENT EGYPTIANS HAD
PYORRHEA AND WERE TOOTHLESS
AT 40, DECLARES DR. ROY L. MOODIE,
UNIVERSITY OF SOUTHERN CALIFORNIA,
AFTER STUDYING MUMMIES



RATS ENJOY GOOD MUSIC AND
APPLAUD IT BY CLICKING THEIR
TEETH, ANNOUNCES DIRECTOR
M.J. GREENMAN, OF THE WISTAR
INSTITUTE, PHILADELPHIA



H.C. BLACKISTON, STEAMSHIP
EXECUTIVE, WOULD REPLACE
LINERS' SMOKESTACKS WITH
STERN EXHAUSTS

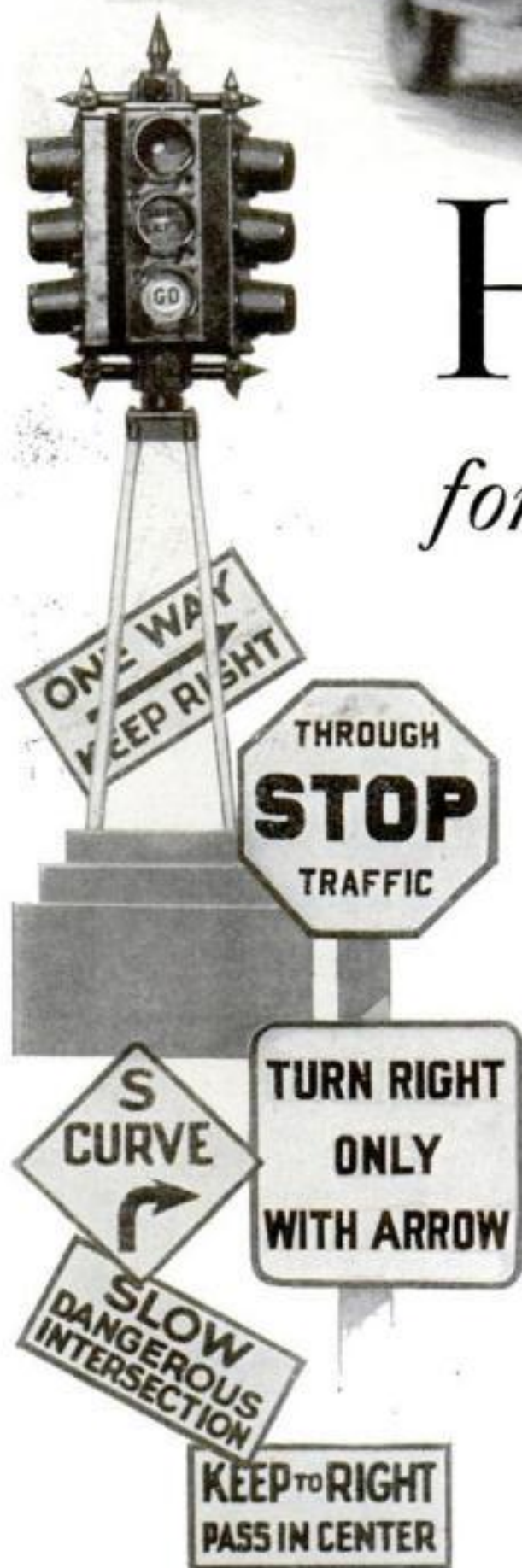


FASTING
INCREASES MENTAL
ABILITY, SAYS DR. J.A.
GLAZE OF KANSAS
STATE TEACHERS COLLEGE



HIGHWAYS

for Your Mile-a-Minute Car



SIGNALS TO MAKE DRIVING SAFE
Traffic engineers have designed various systems intended to protect drivers at dangerous intersections. At top, the old style stop-go device, now largely superseded by signs and signals like those in the illustrations above

FIFTY miles north of New York City, on the Hudson River opposite Peekskill, is a great natural playground called Bear Mountain Park. Week-ends and holidays, throughout the spring, summer, and fall, thousands of people visit it. Until recently reaching it from the city involved a seemingly endless drive in a laggard procession of traffic. The roads led through many towns and the park-bound motorist was delayed by countless "bottlenecks," intersections, and side-roads.

Last November the final link of a remarkable new highway was opened. It is remarkable because, though it passes through thickly populated territory, it enables the New York motorist to drive to the Bear Mountain Bridge, at Peekskill, without entering the streets of a single intervening town. It is one of the first highways in America scientifically designed to meet the demands of modern traffic.

During the last few years, the increased number of automobiles, and the production of cheap cars capable of sustained high speeds, have intensified the traffic problem throughout the United States.

Highways built or rebuilt as recently as five years ago, or even less, are proving inadequate. In all but the most sparsely settled regions, traffic congestion is costing millions of dollars in wasted time, fuel, and car-wear. While in the open country, as well as in towns and cities, a rising accident rate is costing yearly not only vast sums in property damage and injuries, but also thousands of lives.

The trouble is that a great many of our existing roads are merely old-time horse and buggy turnpikes, widened and re-surfaced. As a result they fall far short of

the present-day ideal of what a motorway should be.

Conditions vary so widely in different sections of the country, that it is impossible to set up a standard of highway design that would prove ideal for every part of the country. Each community has special problems which no one arbitrary plan can solve. This diversity of conditions, however, does not alter the fact that all motor routes of any importance must sooner or later be built with certain common characteristics. Everywhere the demand of the motorist, the bus patron, and the shipper of goods by truck is for roads that will permit higher speeds with greater safety.

ONLY lately have highway experts begun to devise means of meeting this demand. Finding little scientific data to work with, they have been forced to gather their own and from it to evolve a set of fundamental principles to guide them.

Progress in any field involves the discarding of old theories for new ones. The traffic problem may be divided roughly into two major sections: first, how to eliminate congestion and danger in and about cities and towns; second, how to make safe the use of high speeds in the open country. Present conditions have been brought about by too long adherence to three outworn ideas. These are:

1. That the function of motor highways is to link town to town.
2. That routing through traffic into the heart of a community is good for business.
3. That local property owners and taxpayers have greater rights in a highway



Cars crossing this viaduct are ordered to hit a thirty-five-mile clip, in line with move for a minimum, rather than a maximum, speed

than have transient automobile drivers.

Studies of traffic flow and accident statistics prove that the principal cause of congestion and danger in urban and suburban districts is the unrestricted mingling of express with local motor and pedestrian traffic. There goes old idea number one.

Studies of the relation to business of traffic delays and parking problems prove that congestion, aggravated by transient cars, costs merchants and business men time and money. Citizens in hundreds of communities who, a few years ago, violently opposed the suggestion that through traffic be routed away from their main streets, today bitterly regret their shortsightedness. There goes old idea number two.

ONCE upon a time it was the primary function of the motor highway to link town with town. That was before the era of long distance travel by passenger car, bus, and truck. The work of connecting towns and cities has, for the most part, been done. Our existing networks of roads would in most cases meet the needs local interurban traffic fairly adequately, were they relieved of the burden of doing double duty.

The main motor highway of today and tomorrow should have but one function: to enable the traveler to reach his destination with a minimum of discomfort, danger, and delay.

Naturally, such a highway must be accessible to and from towns and cities, so that drivers can leave and enter it. But—and here is where old idea number three comes in—all points of entrance and exit must be so arranged that use of them will not interfere with the flow of the main traffic stream.

This means the abolition of random side roads and side streets and crossings, or at least the control and restriction of their use. For the main highway properly belongs to the transient, just as much as to the owner of land abutting on it.

Most of our communities have grown unchecked, sprawling out along the highways in haphazard fashion. There is one town, however, Radburn, N. J., which was planned from the start with the traffic problem in mind. Its homes, placed

Drivers instinctively crowd toward the middle of the road. At right, a colored strip to warn autoists off center unless overtaking car

with their backs to the local streets, face park areas through which runs a network of walks.

Children going to and from school or playground, adults going to and from the shopping center, can do so without ever setting foot on the streets, for the walks pass under them. The streets themselves are dead-end streets, unavailable for through traffic. The main highway takes the motorist to Radburn and past it, but not into it. The mingling of local and express motor traffic and the mingling of pedestrians with either have been permanently prevented by intelligent street planning.

The modernizing of an old highway or the planning of a new one is a complicated business. It is a job for engineers, economists, statisticians, and psychologists. In fact the construction engineer is absolutely dependent on the other specialists. Before a line of a highway plan can be put on paper, comprehensive surveys of actual conditions must be made.

Such surveys include detailed studies of traffic flow at all points on the route under construction, or on routes it is destined to supplant. The authorities must gather figures showing the volume, average speeds, and classes of traffic to be accommodated, together with hourly and seasonal variations in these factors. Time studies must be made at points of congestion and delay, and causes of frequent accidents at specific spots investigated. Present property values must be appraised and estimates made of the probable effect of the project on future values along the route.

The purely technical aspects of road

Speed and Safety Now Prime Essential in Planning New Roads for America By JOHN CHAPMAN HILDER



This clover leaf scheme near Woodbridge, N. J., lets motorists pass in safety from one main highway to another



At Fenimore Road, on Bronx River Parkway, New York, a grade separation of traffic avoids a bad intersection

construction—such as differences in subsoils, climates, foundations, and surfacing materials—are interesting and have a vital bearing on the items of first cost and maintenance. But from the standpoint of bettering traffic conditions the chief essential is intelligent, progressive design.

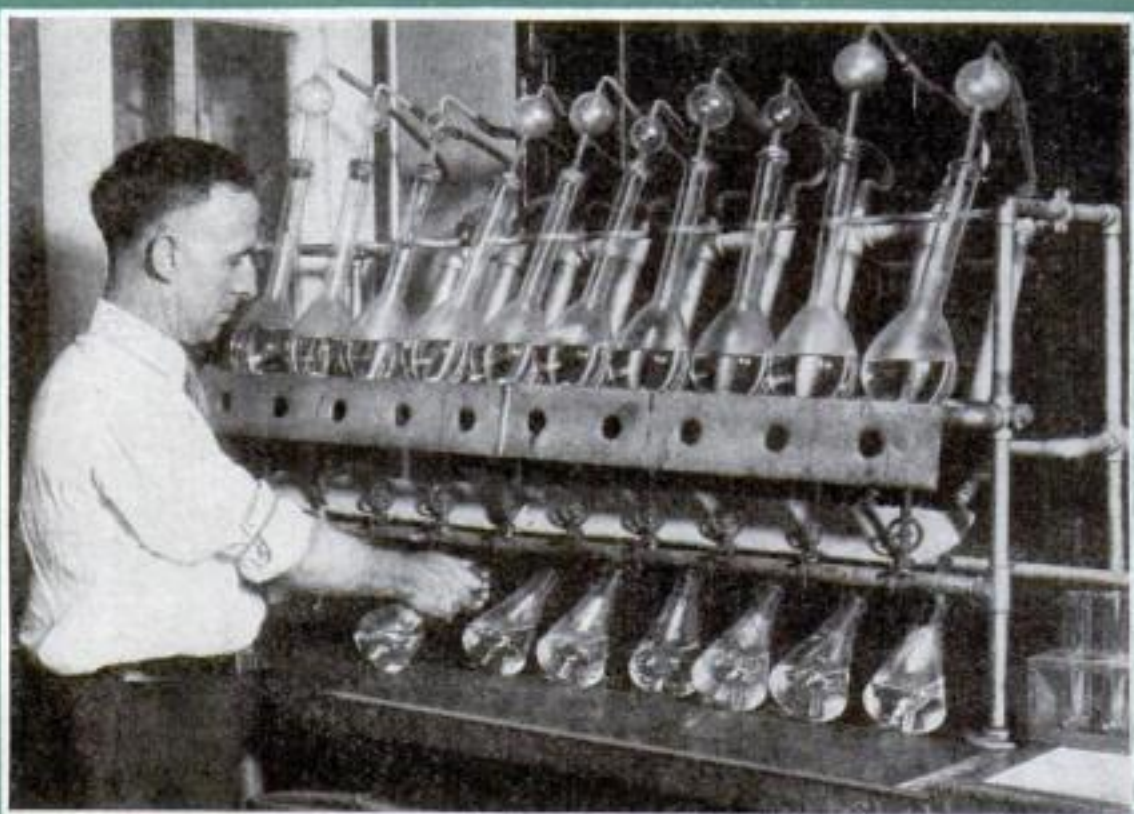
Experts once thought that the principal qualities essential to a good road were width, smoothness, and freedom from curves and

(Continued on page 125)

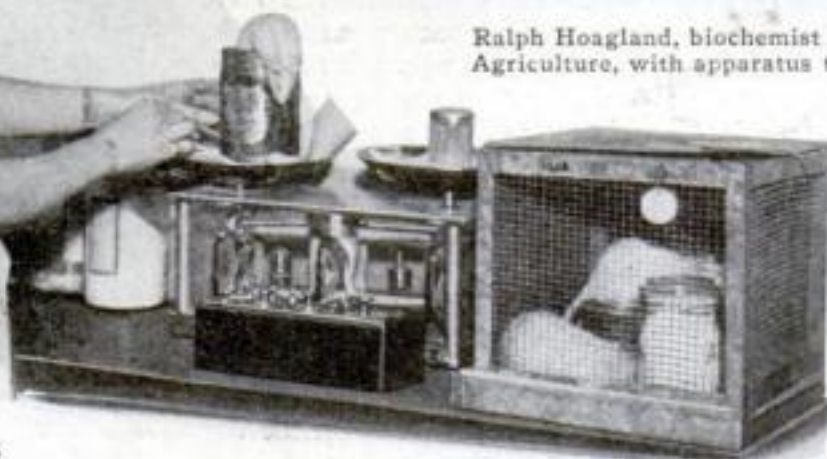
Pedigreed RATS *yield key*



Above, a normal white rat, ready for use as a living test tube in vitamin experiments at Washington. At the right, a research assistant at the Bureau of Home Economics, Washington, weighing a test rat to determine effect of vitamin ration



Ralph Hoagland, biochemist of the United States Department of Agriculture, with apparatus to determine protein content of food



In these laboratories, the main work is discovering the presence or absence of a given vitamin in a given food. In recent years, research in the world of invisible vitamins has gone ahead at a rapid rate. The list of these mysterious elements is expanding all the time.

We now know of vitamin A, which is found particularly in butter, eggs, liver, and spinach, and which produces growth and prevents blindness; of vitamin B, abundant in peas, tomatoes, and asparagus, preventing beriberi; of vitamin C, preventing scurvy and found particularly in lemons, lettuce, and carrots; of vitamin D, the anti-rickets vitamin abundant in cod liver oil; of vitamin E, found in leafy vegetables and grains and promoting fertility; and vitamin G, discovered especially in eggs, milk, and yeast and preventing pellagra.

TO STUDY the effect of any of these vitamins or to find out which are contained in a sample food, the same process is used: try it on the white rats.

Before these living test tubes are ready to be used, they must be four weeks old and weigh at least forty grams. Any rat that weighs less than that when one month old is considered a runt and is culled out. Pigeons, chickens, guinea pigs, cats, dogs, rabbits, goats, and even cows have been used in vitamin tests at various times, but white rats have been adopted as the best animals for such experiments because of the ease with which they are handled, the rapidity with which they reproduce, and the fact that they will eat almost anything.

The only exception is in the study of the anti-scurvy vitamin C. In this case,

THREE English chemists have just reported the attainment of a long-sought goal. By splitting carotin, the pigment which gives color to carrots, butter, egg-yolk, and yellow corn, into two parts, they have succeeded in isolating the mysterious growth-promoting vitamin A.

In their report to the British Society of Chemical Industry, the three men, Prof. J. C. Drummond, of the University of London, and Dr. R. A. Morton and Prof. I. M. Heilbron, of Liverpool University, also state they have obtained from halibut liver oil a sticky, yellowish fluid which is nine tenths pure vitamin A.

A few weeks before, from the Windaus Laboratory, in Germany, came the announcement that vitamin D had been isolated in crystalline form. These are the latest steps in solving the riddle of vitamins—those mysterious health-bringing elements in food so long investigated without having been seen or touched.

If you had to study something you couldn't see, hear, feel, taste, or smell, how would you go about it? How have vitamin-hunters, working in the dark, been able to make their amazing discoveries?

These were the questions for which I sought the answers recently when I visited the laboratories of Government scientists in Washington, D. C. None of these experts had ever seen one of the strange food-elements he studied; none could describe exactly what one was like. Yet, in their research rooms, vitamins had been

studied, catalogued, traced to particular foods, and their astonishing effects discovered and charted. How had this been done?

At the Department of Agriculture, Ralph Hoagland, biochemist of the Bureau of Animal Industry, and Dr. Hazel Munsel, of the Bureau of Home Economics, showed me the long rows of wire cages filled with squeaking, scampering white rats that form the living test tubes used in the experiments. Hoagland is engaged in an elaborate "vitamin census" of the edible tissues of American livestock, and Dr. Munsel is making similar researches in fruit and vegetables.

No ordinary rodents will do for this work. Only those entered in the "Rat Birthday Book" are good enough. This is the record of the animals bred for research purposes in the laboratories. Before a rat is used, the scientists want to know exactly what its grandparents and great-grandparents were like.

When new animals are supplied to the laboratory, two generations are allowed to live and die before the rats are used for experimental purposes. This is done to "stabilize" the animals to be sure they are normal and have no inherited peculiarities that may upset the results of the delicate tests for which they are being groomed. In one year, more than 9,000 rats were entered in the Birthday Book and reached the age of four weeks at the Department of Agriculture research rooms.

to New Secrets of Health

By ROBERT E. MARTIN



In these cages are the test rats, each numbered and isolated and fed an exact amount of certain foods. The assistant is checking up on their condition to see if their food contains the vitamins.

guinea pigs are employed because white rats do not develop scurvy and guinea pigs do.

In testing a food for vitamin content, the animals are selected not from the same litter, but from three or four litters, taking an equal number of males and females from each. Because males grow faster and get bigger than females, this is necessary as a check upon the effect of the tested food. In each step of a vitamin hunt, the food is tried out on from six to a dozen rats.

The twenty-eighth day of their lives is an important one for the white rats. They are carefully weighed, the runts are discarded, and the rest have their ears punched in a distinctive manner so one member of a litter can be told from another. Then each is given a number and an individual wire cage and becomes part of a scientific experiment.

For from two to six weeks, the new recruits are fed on a basal diet containing all the food essentials for growth and health except the one vitamin that is being studied. When the animals begin to show unmistakable effects of this lack, and the scientists are sure they have lost all the remnants of this vitamin which they obtained from their initial four-weeks balanced diet of two thirds whole wheat and one third whole milk powder, they are given carefully weighed doses of the food being tested.

If it contains the lacking vitamin, the

SIX RATS of the same age from the same litter. Each rat had all it would eat of a basal diet of lean beef, potatoes, whole wheat, butter, sugar, and salt, which is a good diet when milk and vegetables are added. No. 1 ate only the basal diet. No. 2 had the same diet plus a small amount of a root and leafy vegetable. No. 3 had a small amount of milk added to its diet. No. 4 had both milk and vegetables added to the basal diet. No. 5, big and sturdy, had all the fresh milk it would drink, plus the basal diet. No. 6 had all the vegetables it would eat along with the basal diet. The difference in the development of the rats is plainly evident. This difference can also be seen easily in the skeletons of the same rats shown at the right, proving bone growth depends on vitamins in the subject's food.

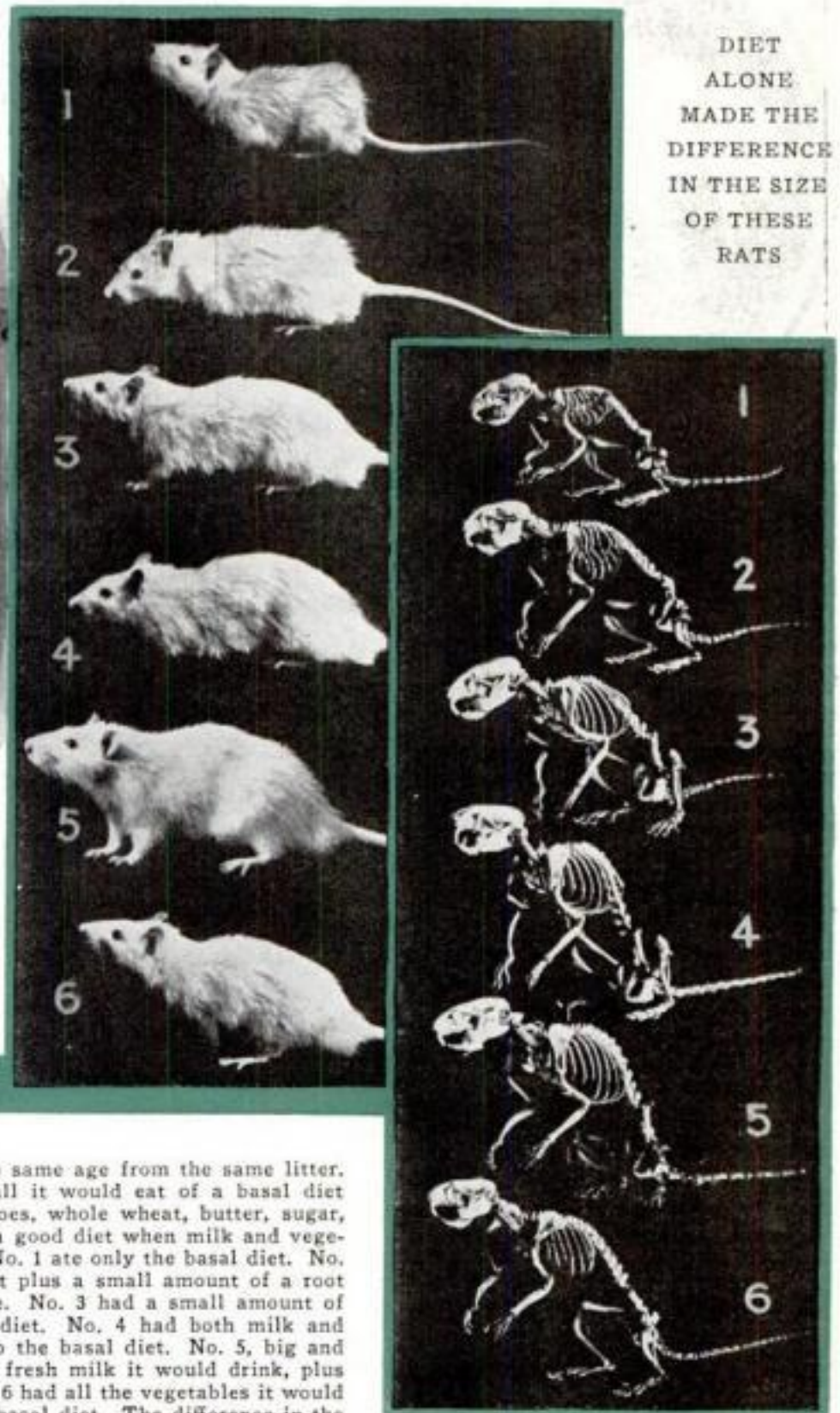
animals respond almost in direct proportion to the amount of the element supplied by the test material. If the food does not contain the vitamin, the test rats continue to decline.

Sometimes, the effects of supplying the deficient element seem almost the work of magic. I was shown one animal with bright, alert eyes and sleek white fur. Then I was handed a picture of the same rat, taken a few weeks before, after it had been deprived of vitamin B for some time. It was then thin, nervous, and racked by convulsions. Within twenty-four hours after the vitamin B was restored to its diet, I was told, it became normal and began a gain in weight and appearance.

After a tested food has been found to contain the element sought, the richness of its vitamin content is next determined. Varying amounts of the food are given to different groups of test rats and the effects are carefully noted and checked.

In this phase of the work, surprises are frequent. For instance, Hoagland told me he found that lean pork is far richer in vitamin B than either lean beef or mutton. Previously it had been said that no lean meat contained much of this vitamin. He also discovered that there is more vitamin G in the liver and kidneys, in beef and pork, than in any other part of the animal.

A veal cutlet, he found, contains less vitamins A and B than calves' liver taken from the same animal. Liver in general is richer in vitamins than the muscle tissue,



DIET ALONE MADE THE DIFFERENCE IN THE SIZE OF THESE RATS



Above, a laboratory worker of the Bureau of Animal Industry placing a rat on a self-feeder. Right, close-up of feeder. Rat gets food through hole in lid

his experiments showed. Probably no other laboratory in the world is making as many vitamin experiments on meat as the one over which he has charge in Washington.

By means of a battery of bottles and burners, the fat and protein content of the meat is determined before it is fed to the test animals. Then it is dried at a temperature of 140 degrees Fahrenheit in special ovens, ground in electric grinders, and divided into carefully weighed rations.

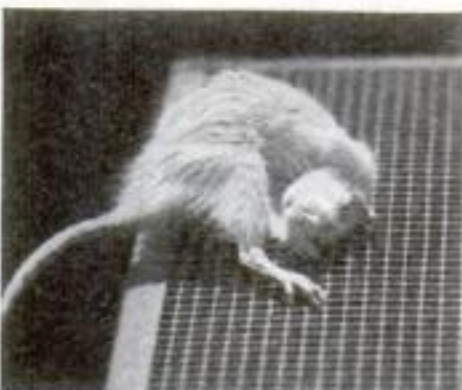
DURING the test period, the rats are weighed either once or twice a week, and variations are recorded by the research staff. The period of a test extends from sixty days to four months. The animals are kept away from all drafts in a room maintained at an even temperature. They are supplied with clean water and abundant food in self-feeding containers.

Yet, irrespective of how much the animal eats, when the diet lacks some essential vitamin it wastes away and falls prey to some disease. A report is made on the physical condition of each rat in its cage once each day. In some cases, I was informed, where an essential vitamin has been supplied after it had been denied to the test animals for a considerable period, they have doubled their weight in a week and a half.

Besides the "test rats," every vitamin hunt requires the services of "check rats." These animals are given the same rations as the others except that when the test animals begin receiving doses of the food under examination, they go on eating the



Deprived of vitamin G, this rat lost much of its hair, its skin became scaly, and the eyes badly inflamed



This rat was fed all it would eat but deprived of vitamin B. It became nervous, thin, and convulsive



same fare as before. While the other animals improve in health, if the food contains the sought vitamin, the check rats continue to grow worse and worse from the ill effects of its continued lack. This proves absolutely that the needed vitamin is contained in the tested material, for these rations are the only thing

fed to the test rats that the check rats do not receive.

After the death of an animal suffering from vitamin deficiency, an autopsy is performed to see what the effects have been upon its organisms. A deficiency of vitamin A, for instance, has been found to result in infections, particularly in the lungs, digestive organs, and the glands of the neck. Deprived of vitamin G, a rat loses hair, becomes scaly, and its eyes grow inflamed.

These symptoms show the presence of the dread disease, pellagra. In the southern states, it is estimated 200,000 people suffer from this malady due solely to deficiency of vitamin G in their diet. Milk and yeast, rich in this vitamin, are potent in stopping the disease both in the test animals of the laboratory and in human patients. Rats, given the pellagra, were fed a wide variety of foods to determine which contained most abundantly the vitamin needed to combat the disease.

IT IS in a similar manner that the initial discovery of a new vitamin is made. The one at the top of the list, vitamin A, was first reported by a Dutch scientist who noticed that birds fed on polished rice fell prey to a disease similar to beriberi. But when the same birds were given rice with the hulls on, they recovered.

Thus it was shown that some unknown element in the hulls was essential to their diet. No one knows exactly what this element is, but tests proved conclusively it exists. Later, this vital unknown element, found in some foods and not in others, was given the name vitamin A to distinguish it from other similar unknown elements which have been found necessary ingredients in the diet for the prevention of other diseases.

Ever since the importance of these mysterious vitamins became known, scientists have labored to prepare them artificially in the laboratory. Synthetic foods of various kinds have been brought to the Washington research rooms and tried on the rats. But they all were shown by the tests to contain no vitamins.

HOWEVER, only a few days ago, two commercial chemists from Evansville, Ind., reported to the American Association for the Advancement of Science that they had produced a synthetic vitamin in the test tube. They are Dr. Charles E. Bills and Dr. Francis G. McDonald, who have spent years of intensive experiment seeking a method of preparing the rickets-curing vitamin D in the chemical workshop.

Until now, it was obtained mainly from cod liver oil, or by irradiating ergosterol, a substance derived from plants, with ultra-violet rays. The Indiana scientists report that they have produced vitamin D by combining ergosterol with methyl alcohol, ether, and ethyl acetate under low temperature with oxygen removed, and then washing the preparation with ammonia. No irradiation is necessary in the process. The synthetic product is not quite as rich in vitamin D as is the irradiated ergosterol, however, for recent improvements in the use of ultra-violet rays in such work permit as much of the vitamin to be stored in one day as can be obtained from 160,000 codfish.

One of the many peculiar discoveries made at the Washington laboratories concerns food irradiated with ultra-violet light. Sometimes, the tests showed, the rays stored up vitamin D, and at other times the rats continued to develop the symptoms of rickets after the food so treated was given them. Finally tests indicated that when the rays bombarded the food for too long a period they actually destroyed the vitamins which at first they had stored up.

ANOTHER of these vital elements, vitamin C, Dr. Munsel told me, is particularly susceptible to heat. Consequently, when food is prepared for tests in the model kitchen of the Bureau of Home Economics, a thermometer is constantly watched by one of the assistants to keep a record of the temperatures to which the material is subjected. This vitamin is entirely destroyed by prolonged heat, so that vegetables which are cooked too long are robbed of this important element. Tomatoes seem to be an exception, retaining most of their vitamin content when either cooked or canned.

Shortage of vitamin C in the diet of humans is thought to be an important factor in tooth decay and rheumatism. When children eat foods deficient in this element they become irritable, lacking in stamina, do not grow normally, and are subject to

(Continued on page 121)

GOVERNMENT ENGINEERS BUILD Indoor Rivers

in Study of Floods and Cataracts



HOW ENGINEERS WILL WATCH UNDERWATER TESTS OF BRIDGE PIERS AND PILING THROUGH WINDOWS

INSPECTION WINDOWS PERMIT ENGINEERS TO WATCH UNDERWATER TESTS OF MODELS IN MAIN FLUME

MEASURING BASIN INDICATES VOLUME OF WATER DISCHARGED FROM MAIN FLUME

SWING GATE DIRECTS WATER TO RETURN CHANNELS, MEASURING BASIN, OR VENTURI PIT

WEIGHING TANKS MEASURE WATER AFTER USE IN SECOND-FLOOR EXPERIMENTS

MAIN DISCHARGE TANK, 43 FT. HIGH, RELEASES TORRENT OF WATER INTO FLUME

MAIN FLUME 12 FT. WIDE AND OVER 200 FT. LONG PERMITS TESTS ON MODELS OF BRIDGES, DAMS AND PILING

REMOVABLE FLOOR PLATES ON RETURN CHANNEL OPEN IT FOR USE IN TESTING SMALL MODELS

TRAVELING CRANE PLACES MODELS IN MAIN FLUME

OBSERVATION PLATFORM

OUTLET

BANKS ERODED AND SAND BARS FORMED BY ARTIFICIAL RIVER TO PERMIT STUDY OF FLOOD CONTROL AND NAVIGATION

VENTURI RECORDING INSTRUMENTS

PUMP EMPTIES MEASURING BASIN

BIG VENTURI METERS MEASURE RATE OF FLOW

VENTURI OPENINGS

Drawing of Government's hydraulic laboratory at Washington in which, by means of real indoor rivers and waterfalls, an intensive study of the movement and force of flowing water will be made. Tanks with a 900,000-gallon capacity will supply the water for these experiments, which are expected to lead to a better control and development of the rivers and cataracts in this country. In circle, how engineers engaged in this work will study flow of water

RIVERS, rapids, and waterfalls will be made to order at a hydraulic laboratory soon to be opened at the U. S. Bureau of Standards, Washington, D. C. In this building, running water will be made to perform all its tricks, and engineers who seek to harness it will have an opportunity to study it.

The laboratory is a brick and concrete structure nearly 400 feet in length. At one end are three stories, but for the most of its length it is two stories high. Its reservoirs hold 900,000 gallons of water.

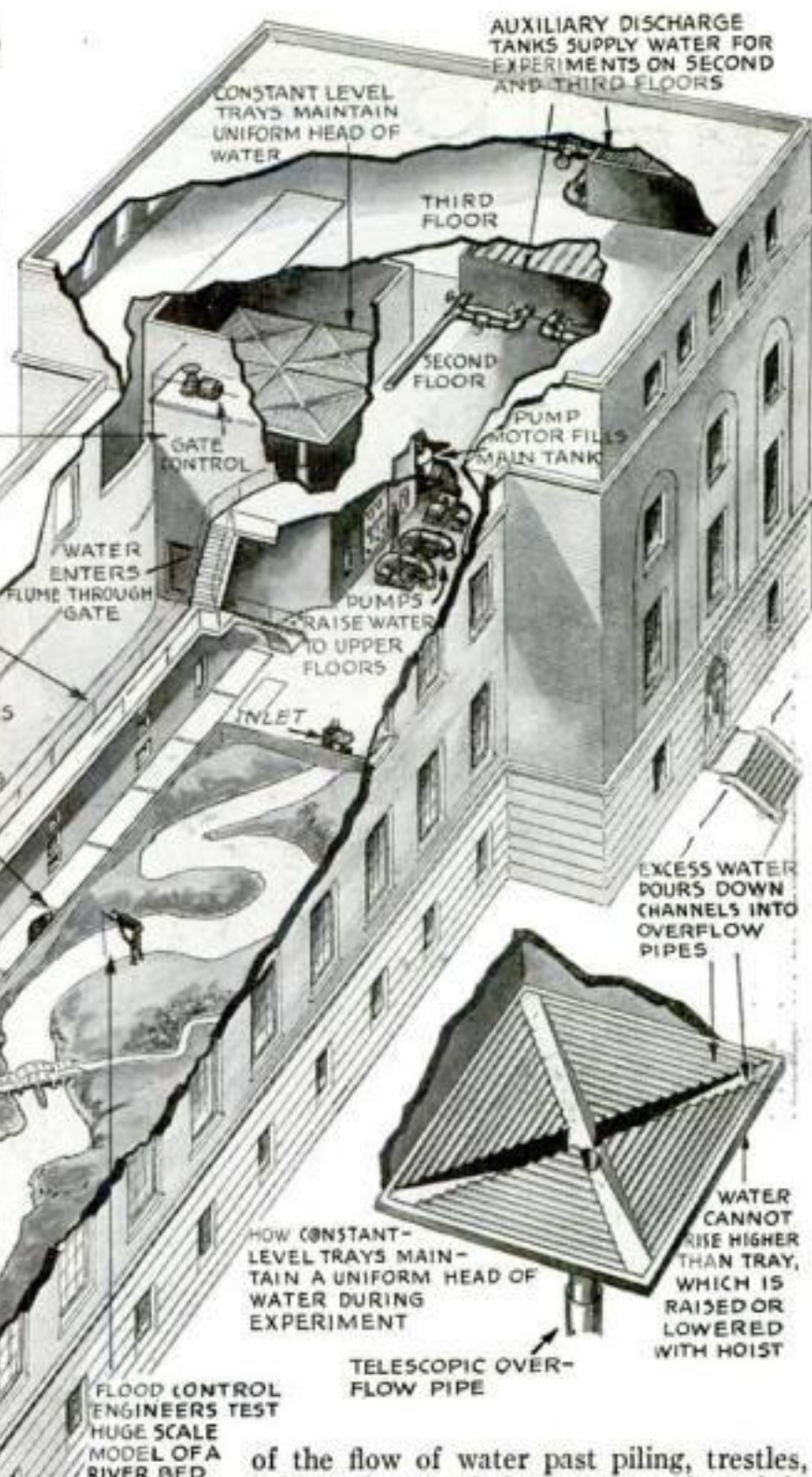
Most of the water is stored in two high- and low-level supply basins. From these it is pumped to smaller tanks from which it is drawn off for experimental use. Study

of the flow of water past piling, trestles, bridge piers, and dams are conducted in the main flume, a concrete channel more than 200 feet in length, on the first floor of the building. The flume is about twelve feet wide, and can be filled with water to a depth of almost twelve feet. Side walls of this flume are fitted with slots holding weirs that measure the flow of water, and models of bridges or dams that are being studied.

The discharge tank for the main flume is twenty-seven feet square and nearly forty-three feet high at the three-story end of the building. Four large trays cover the entire area of the tank. Each has small gutters on its top face communicating with larger gutters extending from the corners of the trays to the centers. Connected with the center of each tray but under it is a telescopic pipe that leads down to the low-level supply basin.

At the end of the main flume is a catch basin. Water from the flume flows into this, and thence is returned to the high- or low-level basin.

On the laboratory's second floor water can be run through river-bed models, the supply for this purpose coming from a separate discharge tank, filled by three electric-motor-driven pumps on the first floor. Water, piped from this tank for experimental use, is drained off into tanks on the first floor, whence it is run back through the high-level return channel.



• Seven Highest Peaks

Undaunted by Repeated Failures, Hardy Explorers Are Determined to Scale Towering Giants in the Himalayas

to whether the use of oxygen tanks is sportsmanlike!

Something of the spirit of the climbers, interested not in money nor fame but in the commendation of their own clan, may be read in the history of their repeated assaults upon the earth's highest citadels. Even the death of two celebrated mountain climbers who started from their highest camp on Mount Everest and were never seen again did not deter another group from trying it in 1930.

And when some lucky mountaineer plants his staff atop the summit of the tallest peak, mountaineers will rejoice with him—but perhaps, secretly, they will feel a little sorry because no higher mountains remain to be conquered.



Real mountaineers are not stopped by a precipice like the one in above photo, in Swiss Alps. At right, man lowers himself down a cliff with knot invented by mountaineer



WHO are the men who will scale the world's seven highest peaks?

This is the number to which the roll of famous mountains unconquered by man has dwindled, since Frank Smythe led a British expedition last summer to the 25,447-foot summit of Mount Kamet in the Himalayas—the highest mountain yet climbed by man. Above it tower successively the Himalayan peaks of Nandadevi, Nanga-Parbat, Dhawalagiri, Makalu, Godwin-Austen, Kanchenjunga, and finally 29,141-foot Everest, highest in the world.

Only a challenge to the hardy brotherhood of mountaineers, rather than a discouragement, is the mile that Everest raises its head above Kamet. A scant mile, but one filled with desperate adventure for the climber. At such heights men grow dizzy for lack of air. Even oxygen tanks are often more of a hindrance than a help where precipices must be scaled and treacherous footholds hacked from snow. Yet controversy has arisen among mountaineers themselves as



Crevasse like the one shown here yawn hundreds of feet deep across the path of Alpine climbers. Covered with loose snow, they form death traps.

Challenge Climbers

The rescuers found the man alive and at right he is being started on the perilous trip to safety on the back of comrade

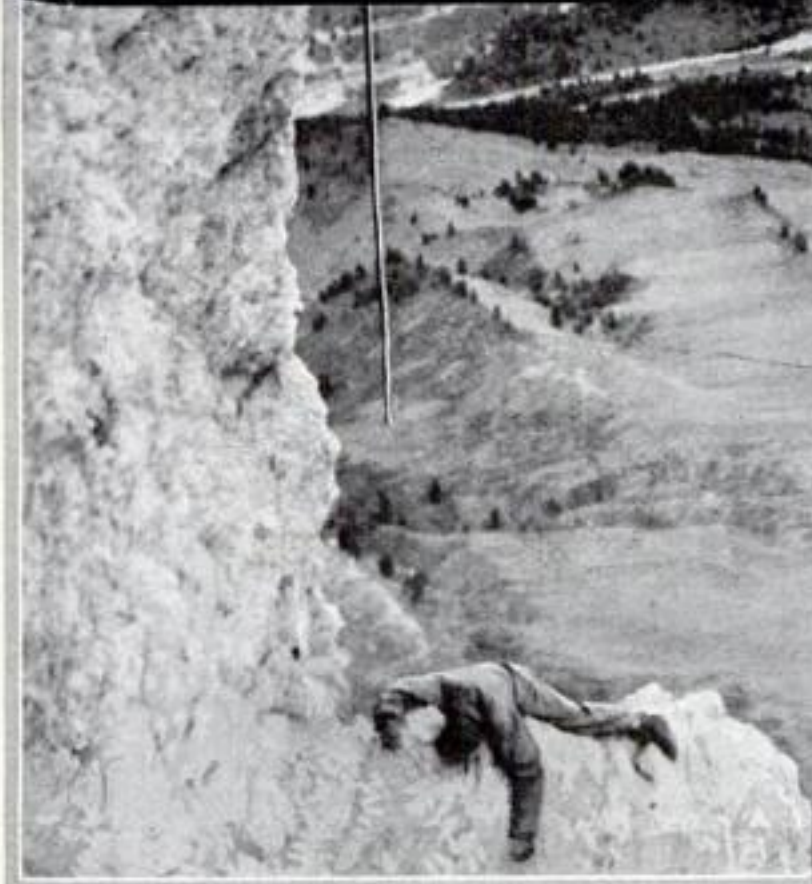
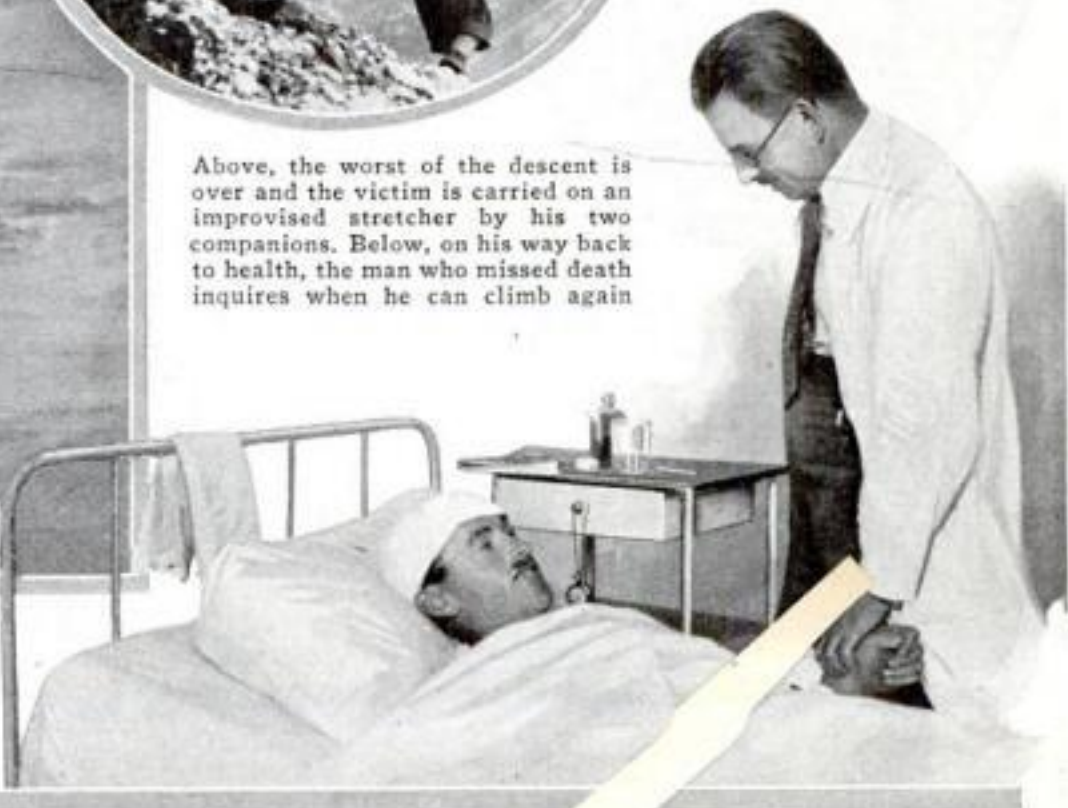
Below, the injured man is lowered on ropes down a precipice too steep to carry him. His broken leg is supported by rope



*Photos tell
Thrilling Story
of Fall and
Rescue of
a Mountain
Climber*



Above, the worst of the descent is over and the victim is carried on an improvised stretcher by his two companions. Below, on his way back to health, the man who missed death inquires when he can climb again



A misstep plunged this mountain climber over the edge of a cliff and only a chance ledge saved him from instant death. While he lay there unconscious, his companions arranged a rescue. First they tested the rope by which they would try to reach him, though they did not know at that time whether they would find him alive or dead



German housewives, some of them, are wearing this striking costume to guard themselves from the dust their brooms raise in sweeping

THIS GRUESOME MASK PROTECTS HOUSEWIFE

Dust has no terrors for the housewife who wears the strange costume illustrated here. It was recently exhibited in Germany as an example of hygienic protection to complexion and lungs during housecleaning, though its formidable appearance leaves room for doubt as to how widely it may ever be adopted. However, it is said the mask makes it impossible for the one wearing it to breathe in dust or lint.



USE PLANE'S PROPELLER TO SAVE FRUIT TREES

AN AIRPLANE propeller, revolving atop a steel tower, is being tried out experimentally to save the orange groves of central California from frost. According to the theory of the builders, it will replace the cold air near the base of the trees with a warm draft from above, thus raising the temperature and avoiding the smoke nuisance of the smudge pots ordinarily used for the purpose. The propeller swivels on its base like a revolving air beacon, so that it is able to throw an air stream in all directions.

STRANGE GOLF CLUB HOLDS UMBRELLA

ALWAYS ready for a sudden shower is the golfer who includes in his bag a new type of club. On the green it serves as a putter, but when it rains its hollow interior reveals a tightly rolled silk umbrella. Despite its unusual construction, the club is said to be a satisfactory putter. A Springfield, Mass., golfer invented it.



SEAT ON AUTO IS A "BUCKING BRONCHO"

A SYNTHETIC "bucking broncho" introduces the Eastern tenderfoot to the art of desert riding on a ranch near Palm Springs, Calif. This odd variation of a rumble seat, mounted on the back of a car, bumps up and down during a trip across the sand ripples and sagebrush. By clinging to it a would-be rider learns the tricks of keeping in his saddle—and should he slip, he does not have far to fall.



The tenderfoot on a Western ranch gets his first experience with bucking bronchos when he rides this seat rigged to a car's back



STREET CLEANER RUNS ON CAR TRACKS

RUN BY electricity, an unusual type of street sprayer that resembles an electric locomotive has made its appearance in Italy. It runs along the street car tracks, flushing the highway clean with jets from

the nozzles of its capacious tanks. It gets its power from overhead wires.

FUEL GAS FROM COFFEE RUNS KITCHEN RANGES

WHEN a Brazilian housewife in the city of Nictheroy makes the coffee on her kitchen range, the gas that heats it is itself obtained from coffee. Seeking a way to get rid of surplus stocks of inferior grades of coffee, Brazilian scientists have discovered that the brown beans may be made to yield a fuel gas of superior combustibility to that manufactured from coal. An experimental plant now supplies the whole city of Nictheroy with "coffee gas."

EXHIBITS MODEL OF MIGHTY CATHEDRAL

A one-ton plaster model of Cathedral of St. John the Divine, now being built in New York City, recently exhibited, is cast on a scale of a quarter inch to the foot and is twelve feet six inches in length and eight feet six inches high

RUBBER CUP MUFFLES VOICE IN SINGING

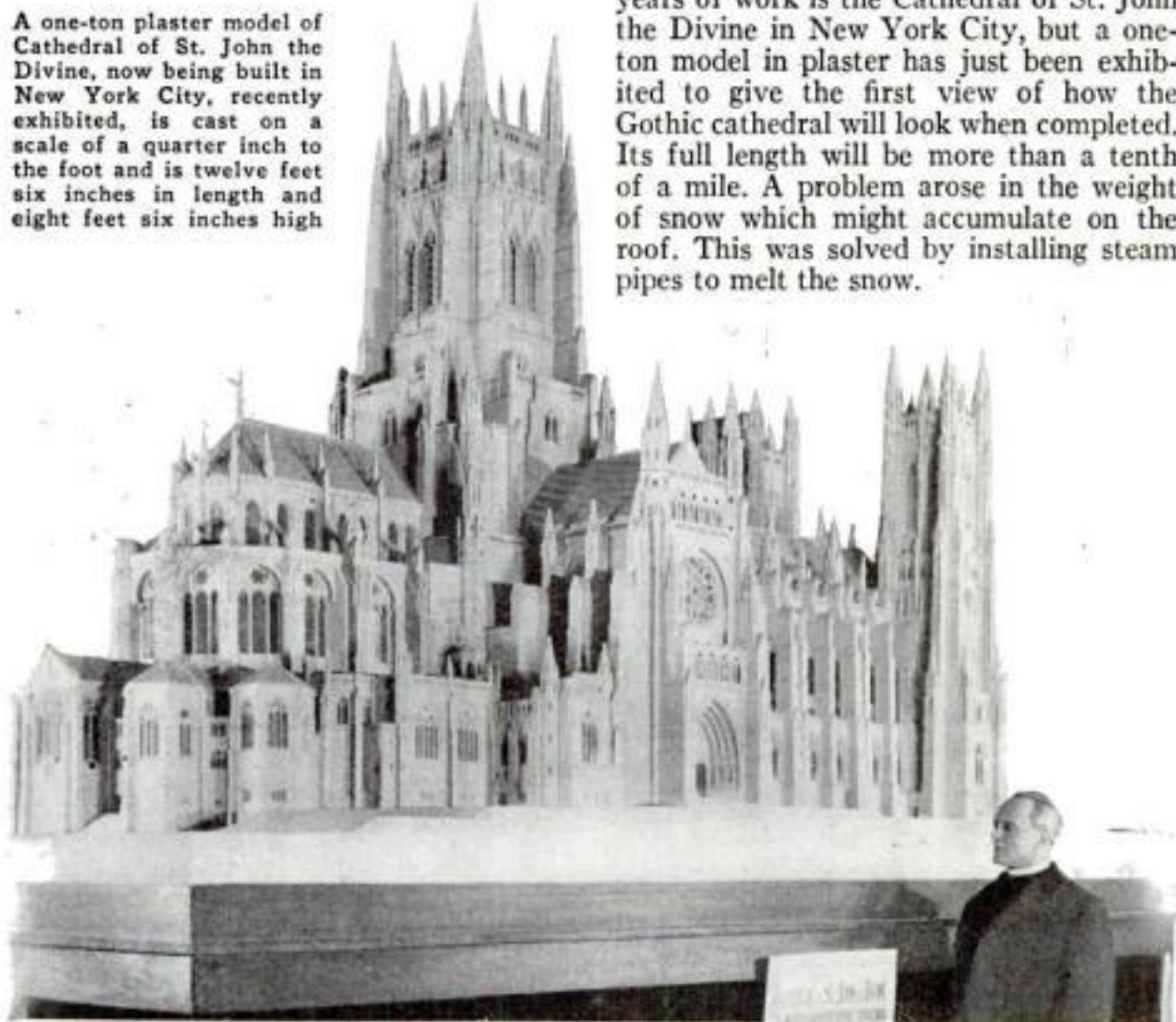
BUDDING vocalists may now strain their hardest to reach high "C," yet their neighbors will not suffer. In a British invention that permits silent singing practice, shown in the photograph, the performer sings into a rubber cup fitted over the lips and listens to the sound conveyed through tubes to the ears. The singer may run the scales or practice difficult passages, yet hardly a sound can escape. The device aids a singer in analyzing and correcting faults, because of the better opportunity to hear the sound, which is amplified in the tubes.

Muffling the voice in a rubber cup, the singer can hear her notes through tubes in the ears



MARCONI WORKS WITH ULTRA-SHORT WAVES

JUST as an automobile headlight reflector throws a narrow pencil of light, so can a reflector of the same "parabolic" shape, built of solid metal or wires, concentrate a beam of radio waves in a given direction. Latest experiments in transmitting ultra-short waves in this way have been conducted along the coast of northern Italy by the famous radio pioneer, Guglielmo Marconi. A successful radiotelephone conversation was conducted between Santa Margherita and Levanto on the ultra-short wave length of half a meter. Reflectors were used, both at the sending end to direct the beam and at the receiving station, shown in the photo, to focus the received beam upon the pick-up apparatus. Enormous economy of power is the advantage of transmission on such a concentrated beam.



New Air-Driven Boat Skims Surface of Water



Below, all ready to be launched. The air-driven boat is designed to accommodate five passengers. Note the motor that is just visible in bow

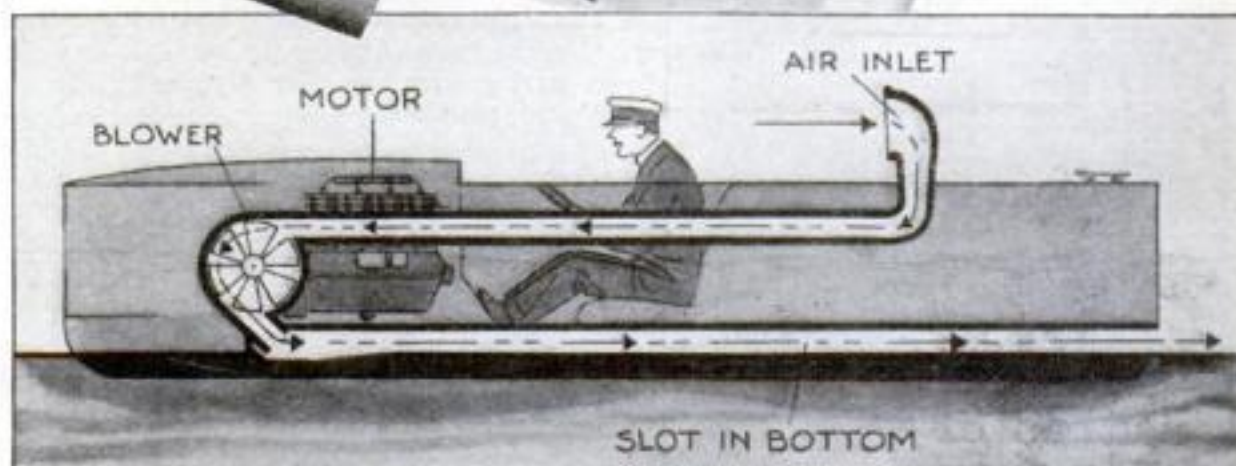
Jets of air forced out by powerful blowers propel this strange pneumatic boat shown above speeding across the water at Freeport, N. Y.

DEVOID of propeller and rudder, a boat of a new and possibly revolutionary type slid down a launching platform near Freeport, N. Y., the other day, and scudded along the bay under its own power. A pair of motor-driven blowers, shooting jets of air backward along slots in the bottom of the hull, propelled the strange fourteen-foot craft.

This pneumatic boat is an experimental model of a type of pleasure craft adapted to commercial production. It demonstrated, according to its designer, Christian A. Volf, whose inventions in the realm of acoustics and aviation have been described before in this magazine, that the blowers enabled it to run more economically than a conventional screw-propelled craft, and with less vibration. Moreover, the new design may open the way to build boats of unheard-of speed. Volf has already begun building a twenty-foot craft, powered with a 150-horsepower engine and made of lightweight metal, which he predicts will smash all existing speed records for water craft.

In the model just tested, the idea of "jet propulsion" for water vehicles by means of streams of air, water, or gases instead of a turning propeller comes close to practical realization, after having lain dormant in the minds of engineers for more than a hundred years. To make this possible, Volf invented and patented a new type of blower whose three-edged air scoops can rotate at enormous speed without breaking, because of their peculiar structural design. When the photograph at the top of this page was taken, the rotors were turning at 6,000 revolutions a minute under the power of a four-cylinder engine.

The blast of air not only drives the boat forward, but lifts it several inches



The boat turned on its side to show the slots in its bottom through which jets of air are forced. Keels hold air in at sides

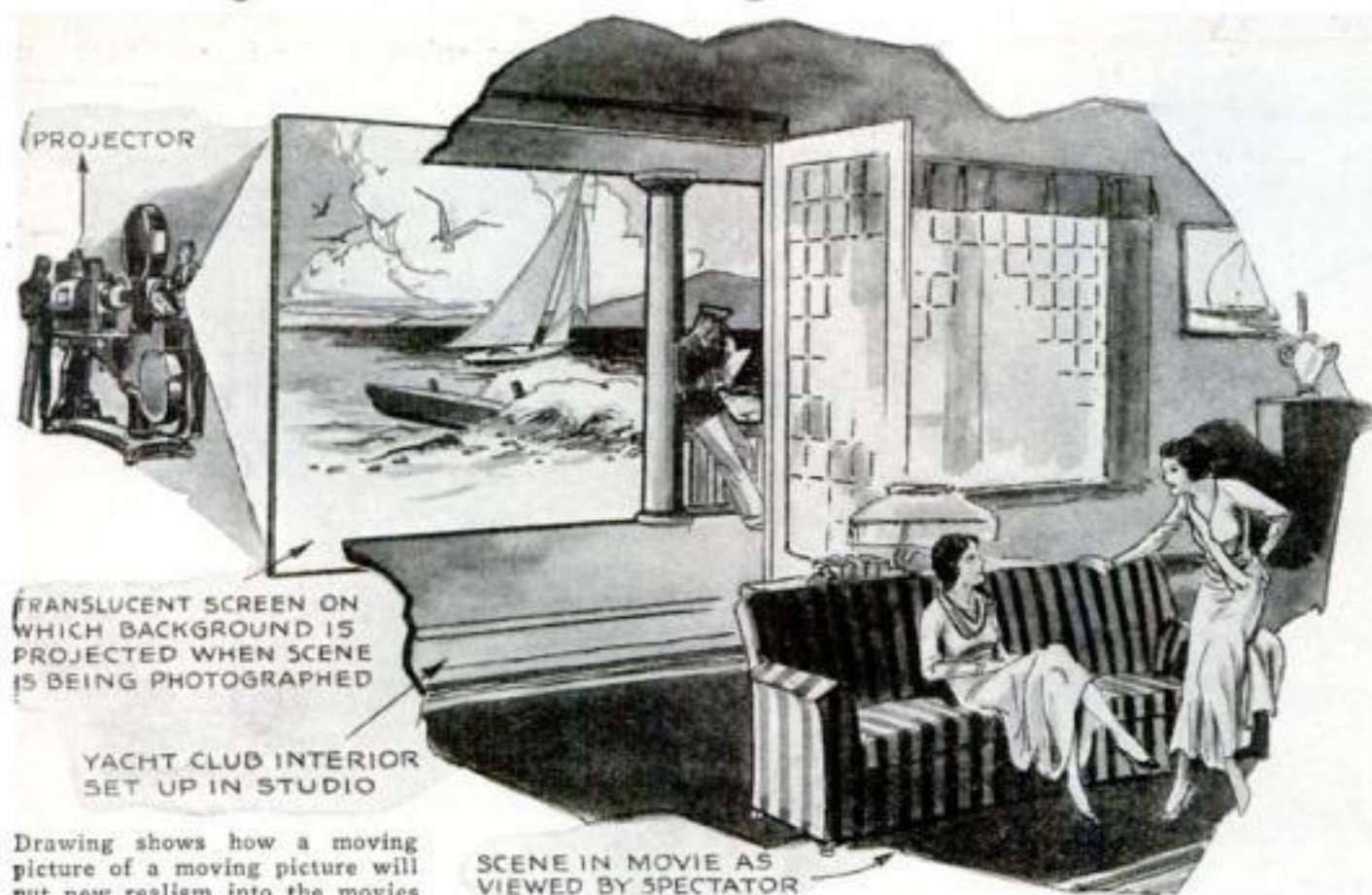
Upper left, model of the motor-driven blowers that propel boat by shooting streams of air through slots beneath it. The path of the air is indicated in the diagram shown above

off the water until it rests only upon its three triangular keels, so that it offers the least possible resistance to forward motion.

His own bathtub furnished Volf a testing basin to try out his original model, a twenty-inch block of wood shaped to

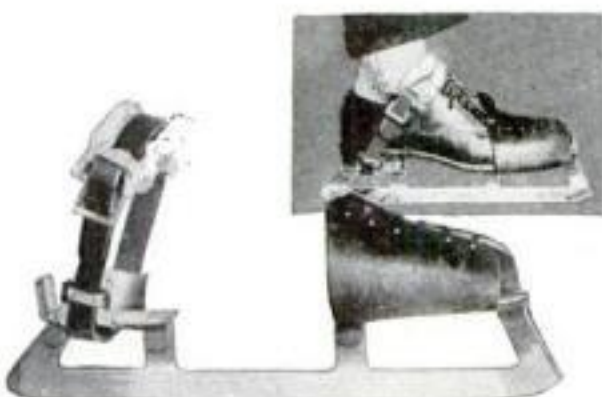
represent a boat and equipped with air tubes. A vacuum cleaner with its bag removed served as an improvised air pump. To Volf's delight the model scooted around the tub with encouraging vigor. After testing a larger model in the Hudson River near Weehawken, N. J., with a self-contained electric blower operated from a trailing wire, Volf started work on the full-sized boat in a garage near the Freeport beach. The rotors, he found, spun safely 10,000 times a minute unless strained by jamming on power suddenly. Volf risked his life in tests until he devised a foolproof throttle that applies power gradually.

Moving Picture of Moving Picture Gives New Touch of Realism



ACTUAL motion pictures, projected on translucent screens, are now being used by California studios in the filming of picture plays. They supply a realistic background representing a scene supposed to be viewed through the window of a home, train, taxicab, or other building or vehicle.

In one scene, for example, two girls were at a yacht club during a regatta. Meanwhile, through a window, sailboats were to be seen rounding the markers. This was accomplished in the manner shown in the drawing. The "window" was a frosted glass screen, on which a projector cast pictures of the sailboats. Meanwhile, the camera on the set, synchronized with the projector, filmed both the girls and the boating scene. By this means the latest touch of realism is added to the picture world.



HARNESS FITS SKATES TO STREET SHOES

SKATES may be put on, right over the wearer's street shoes, with a new harness that is said to make as secure a fastening as if the skates were riveted to the soles. At the front is a leather toe drawn tight with laces; a strap secures the heel.

WASHOUT SHOWS CONCRETE'S STRENGTH

AN UNSUPPORTED length of concrete pavement demonstrated its strength when a cloudburst swept away a state highway bridge near Barnum, Minn., not long ago. The pavement formed a temporary link so that the washout was invisible to motorists. Highway repair men found that more than twenty cars had passed over the concrete without cracking it. They hastily erected temporary bracing.



Concrete pavement, left unsupported after a washout, did not fall under its own weight

LIMESTONE CABINET HOUSES RADIO SET



Radio cabinet made of slabs of limestone joined without cement

WHEN a twenty-six-year-old Indiana sculptor set out to build himself a radio cabinet, he chose limestone as his material. Carving the front and side panels by hand, he assembled the twelve stone slabs to make a 400-pound cabinet. The stones, carefully jointed, were put together without the use of cement or fastenings of any kind. This made it possible to move the cabinet easily in spite of its weight. Not only decorative is this unusual housing for a set but, according to its designer, the rock case gives his radio unusual mellowness of tone. Its design makes it appropriate for hotel and theater lobbies as well as in the house, and several who have seen the cabinet have ordered duplicates.



TWENTY-TWO PLATES PUT IN LAMINATED PADLOCK

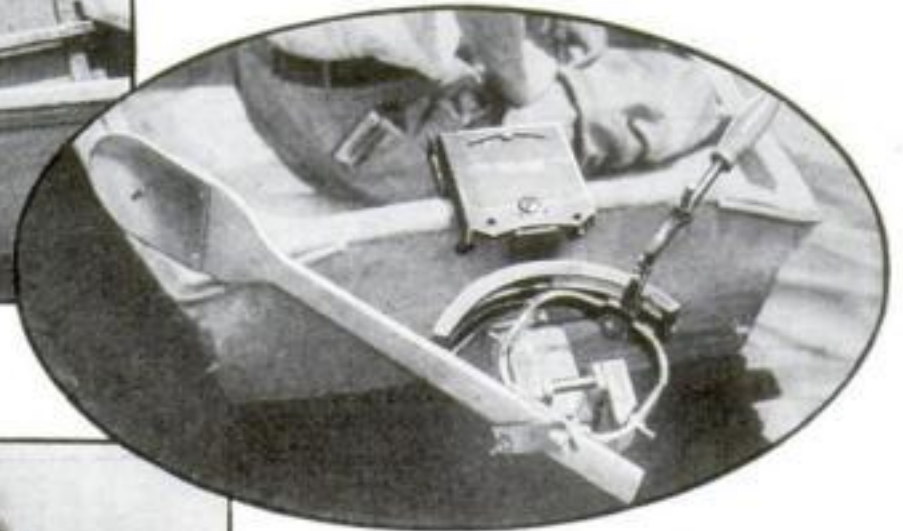
THE laminated design of bank vault doors, where great strength is required, inspired a veteran locksmith to invent a new padlock that has just appeared on the market. Twenty-two plates of steel are riveted together under 150 tons' pressure to form its body, which the maker declares is even stronger than a solid steel block. A coating of pure cadmium metal rustproofs the outer surface, and a steel jacket guards the lock mechanism against tampering.

Crank in Fisherman's Boat, Run with One Hand, Replaces Oars



Crank attached to fishing boat to revolve a paddle in figure eight to propel and steer craft is easily operated with only one hand

A NEW mechanical paddle for the fisherman leaves one hand free to hold the fishpole. With the other, he moves a crank back and forth. This imparts a figure-eight motion to a wooden paddle at the stern of the rowboat, propelling it silently through the water. With a little practice, the fisherman can steer the boat from side to side by exerting a little more pressure in one direction than the other in completing the stroke. No special directions are needed to learn the operation of the mechanical paddle, and the novice at boating, it is said, is likely to master its use more easily than that of oars or canoe paddle. With it an angler can troll without a companion to do the rowing.



Close-up of the crank and paddle showing how they fasten to boat to take the place of oars

SOLDER FOR ALUMINUM HOLDS WITHOUT FLUX

POTS and pans, and other household articles of aluminum, are easy to repair with a handy solder that recently has been placed on the market. This solder may be melted by the heat of an ordinary gas stove, and applied to small articles without flux. According to the maker, the solder actually fuses with metal to form a lasting weld, saving utensils that would otherwise be thrown away as useless.



STARS IN VISOR SIGNAL STATE OF CAR BATTERY

A NOVEL device recently placed on the market reveals the condition of a car's battery by the color of three illuminated stars within a visor, one electrically connected to each cell. All green indicates a fully charged battery; dead cells are revealed by red stars.



Electrically operated stars in this visor, connected with car's battery, signal condition

SEX REVEALED BY HANDWRITING

THOUGH most claims of so-called "graphologists" who read character from handwriting are devoid of scientific foundation, recent tests at the University of Illinois show that the sex of the writer may often be revealed by penmanship. Fifty specimens of writing were distinguished by untrained student judges with an accuracy of sixty-one percent.

NEW TALKIE CAMERA WORKS IN VACUUM

NO WHIRRING of the shutter in the newest camera for the talkies can enter a microphone standing right beside it, for the camera works in a vacuum, through which sound cannot travel. An air-tight housing surrounds the instrument. When its doors are closed, a pump exhausts the

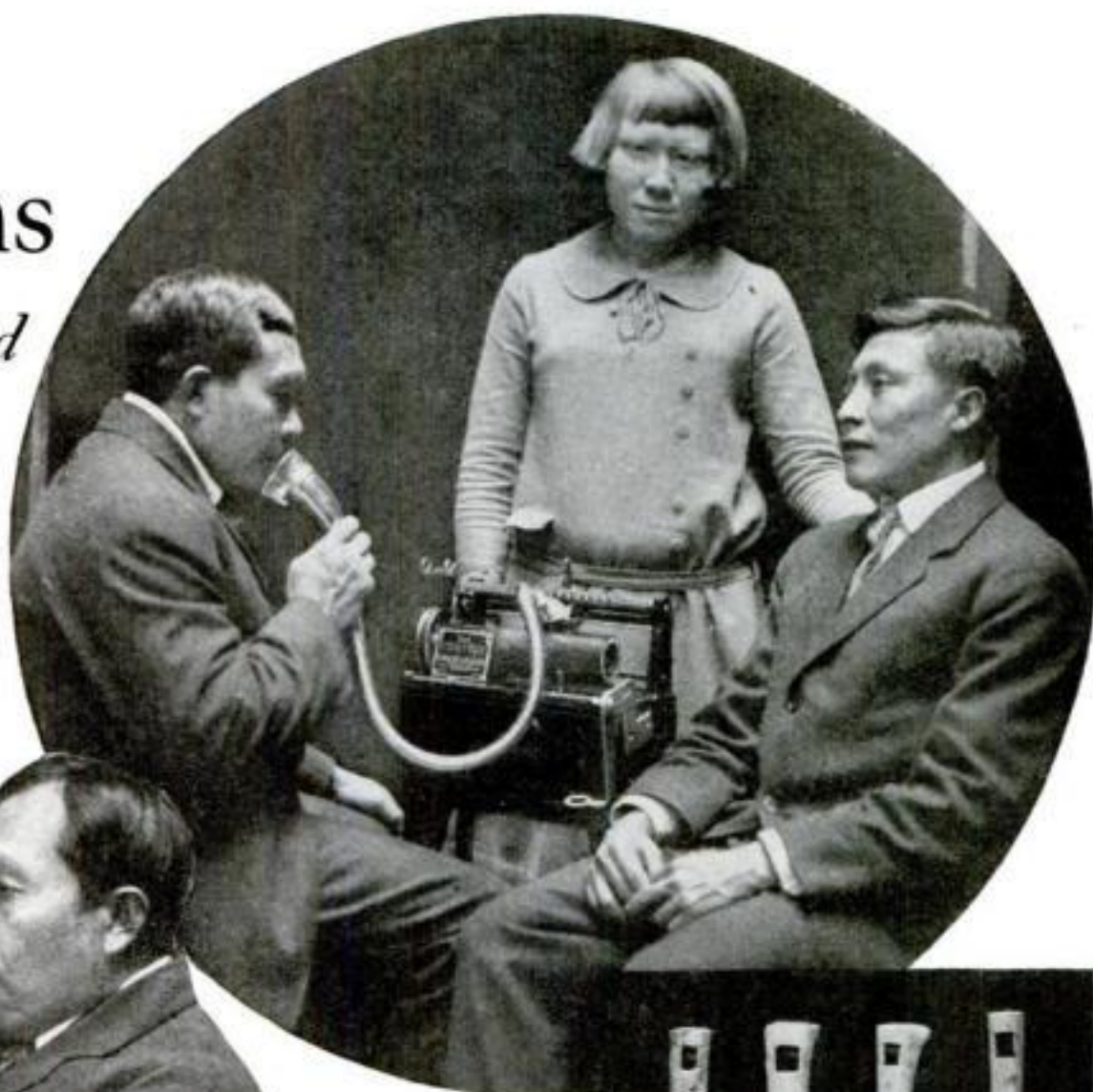
air inside within twenty-five seconds. The housing does not interfere in the least with the operation of the vacuum camera, which is run by a self-contained electric motor. A gage at the rear warns if the vacuum is diminishing. This invention is designed to replace bulky housings.

MYSTERIOUS White Indians

Link New World to Old



White Indian women, who live in the jungle region of Central America, wear necklaces of silver coins. At right, Indian playing a shell



Phonograph records are being made of the songs and language of white Indians. Their dialect suggests Sanskrit

OUT of the tangled jungles of Panama, three white Indians have been brought to Washington, D. C., by Government scientists who are trying to solve an old mystery.

Legends have been told, for centuries, of a mysterious race of fair, yellow-haired natives inhabiting the jungles of Central America. Recently, while exploring the wild islands off the coast of Panama, Mathew W. Sterling, of the Smithsonian Institution, discovered a colony of the light-skinned natives. He persuaded two men and a girl to return with him.

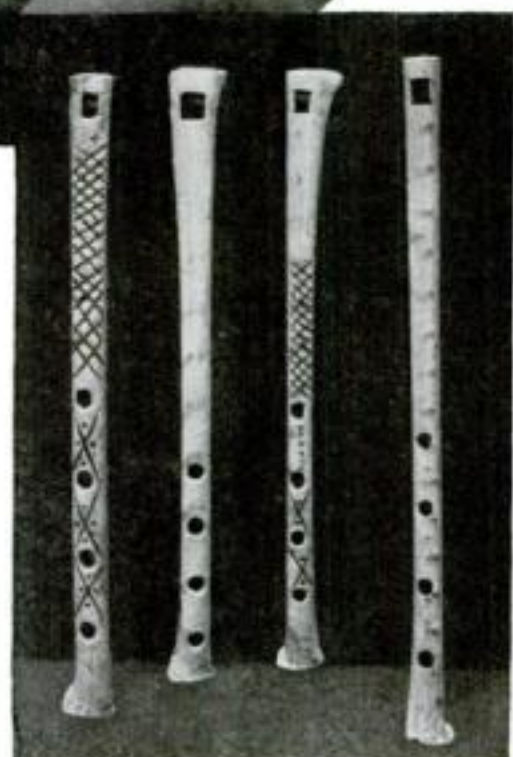
Scientists at the Smithsonian Institution are now studying their customs, their strange speech—unlike any other dialect known to linguists—and their curious music, made with sea shells, hollow bones, and pebble-filled gourds. Permanent records are being made.

Already, the investigators have made an astonishing discovery. All previously known Central American Indian dialects show clearly their Mayan origin. But the language of the white Indians appears related to Sanskrit, the tongue of the ancient East from which developed Greek, Latin, and their descendant languages.

In studying their queer instrumental music, Miss Frances Densmore, an international authority on Indian melodies, spent weeks recording the weird jungle rhythms which they created with their conch-shell trumpets, Panpipes, and whistles wrought from the wing bones of pelicans and buzzards. A gourd rattle is used to produce a soothing melody with



White Indians, now being studied in Washington, make a strange music on Panpipes or tease weird melodies from the gourd rattles pictured at right



Above, close-up of white Indians' queer whistles made from wing bone of pelican or buzzard. Below, a native musician playing a tune on a bone whistle



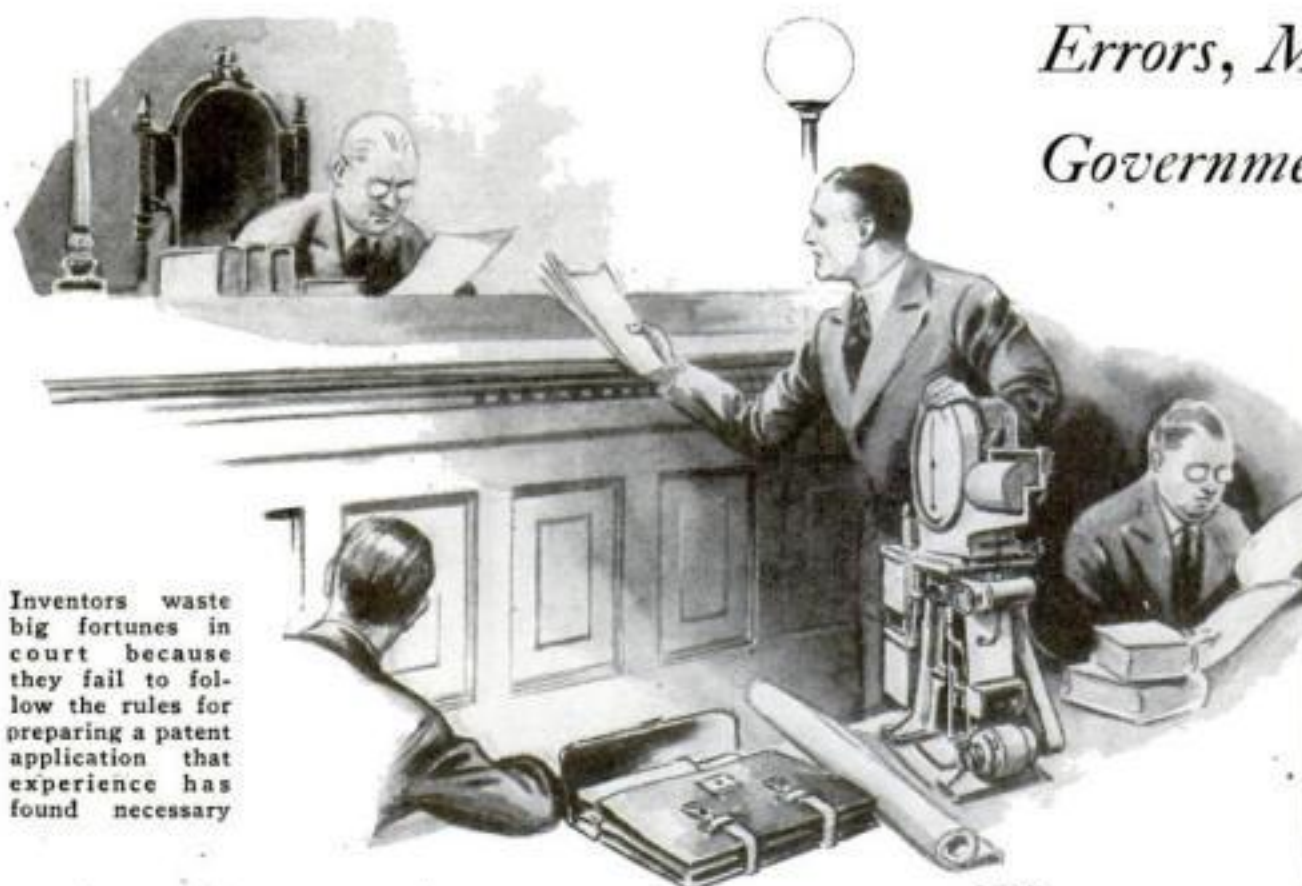
which the native mother lulls her child to sleep. Unlike other Indians, the white tribesmen are opposed to war.

Various theories have been offered to explain the origin of these fair-skinned junglemen. Some scientists have suggested they may have descended from lost wanderers who crossed the sea from the Old World in prehistoric times. Others have thought them the remnants of a race which once ruled the shores of the Caribbean, and still others have maintained that they are simply albinos. This latter hypothesis has been definitely disproved by the studies made at Washington.



10 ways to Keep your

*Errors, Misleading Statements,
Government Officials May Rob*



Inventors waste big fortunes in court because they fail to follow the rules for preparing a patent application that experience has found necessary

AFTER years of costly litigation, the inventor of a process worth a fortune has just failed to get a patent because, in his original application to the Patent Office, there was an error of a single word!

The latest issue of the Patent Office Gazette, as this is written, gives the details of his unfortunate experience. In 1921, this inventor discovered a way to prevent deposits of salts from water inside the boilers of steam engines, something that costs industry millions of dollars a year. The material he used for the purpose was prepared by soaking flax and other oil-seeds in water containing soda and starch and then treating them with steam.

To the average person, steam means only one thing. But to the expert, it may mean any one of a wide variety of vapors, ranging from the transparent "super-heated" kind down through foggy "wet" steam to the hot water of the "condensed" variety. In his process, the inventor used steam which was changing from "wet" to "condensed." He thought the moisture was entirely condensed and described it thus in his application. Six years later, he discovered his mistake. Only when the steam was still foggy was his process a success. In effect, he had never applied for a patent on his idea at all!

In Washington, his patent was still pending. He immediately sought to alter the word "condensed" to "wet." The Patent Office refused his request. According to the law, an inventor must apply for a patent within two years of the first public use of the invention. As the process had had widespread commercial application during the intervening six years, the inventor was told it was now too late to apply for a

By
EDWARD THOMAS

patent on the correct process. He appealed the decision and now, after four years of bitter struggle, he has just seen the fortune slip from his fingers by a final decision of the U. S. Court of Patent and Customs Appeals.

I remember another case in which the inventor of a pill-making mechanism described it in his application as coating the pellets with glycerin instead of what was actually used, gelatin. In this instance, a judge held that the error was unimportant because it was the operation of the machine rather than the material with which it coated its product that was new and being patented.

However, the slightest error in specifications, if the courts hold it is important, may lead to the loss of a valuable patent.

Consequently:

Check over your specifications until you are positive they are correct before sending in your application.

That rule heads this list of suggestions for keeping your patent out of trouble. A second difficulty to be avoided is illustrated by an experience I had several years ago.

An inventor brought me the model of an electrical counting machine upon which he wanted to get a patent. He was leaving immediately for California and asked me to have all the drawings and specifications ready when he returned a few weeks



As soon as possible make a working model of your invention to prove it has real value to industry and is not just a paper patent

later. That job was the hardest I ever tackled in twenty years of practice because the model was full of dead wires. As the inventor perfected his machine, he had abandoned a number of tentative hook-ups as wrong or unnecessary, but he had failed to remove the dead wires. When I turned on the current, I had no idea which wires were dead and which carried electricity and should be in the drawings.

For sixteen solid days, I worked with that model before I finished the papers. By magnetizing a small sewing needle and dangling it on a thread over each wire while the machine was in operation, I finally discovered which ones carried current. By removing the wires having no effect upon the needle, I was able to clear out the mass of rubbish.

Had any of the unneeded connections appeared in either the patent drawings or the specifications, a court might have held the patent void because it contained misleading material. The law requires that an application must contain sufficient information about an invention to enable anyone by using it, and "an admixture of intelligence," to duplicate the thing invented. In other words, it must contain everything that is essential to the invention and nothing that is not. In a number of cases, where misleading material has been included in an application, either inadvertently or by intent, courts have held the patents worthless on such grounds. Hence, the importance of rule two:

Be sure there is nothing misleading in the application.



Be sure the words in your application convey your exact meaning

Patent *out of* Trouble

Omissions, and Delay in Application to You of the Fortune Your Idea Is Worth

Closely related to this rule is another. When applying for a patent, you cannot hold back anything essential to the invention. That is, you cannot keep part of your invention a secret and still get a patent that will hold in court. When it is shown that an inventor has intentionally done this, the courts declare the patent void.

Such was the case, a few years ago, with a highly valuable process for making sponge rubber. Before two Americans invented this process, all rubber sponges came from abroad, where they were manufactured by a method kept a trade secret. In the American process, the rubber was pounded, or "milled," until it was like soft chewing gum. Then particles of bicarbonate of soda, or a similar chemical, were worked into the plastic mass. When the rubber was heated in the mold, each chemical particle gave off gas, thus forming cells with thin rubber walls between them.

Soon after the new sponges appeared on the market, the owners of the patent sued a manufacturer for infringement. In court, this man proved that in order to make good sponges, the walls between the cells had to be broken down so water could flow between them. For some mysterious reason, which no one has been able to explain satisfactorily, this occurs only when paragon, a chemical made from the

oil found in the corn germs left behind in starch-making, is mixed with the rubber. This necessary ingredient was mentioned nowhere in the patent. Consequently, the judge held the patent void because it failed to fulfill the requirement of giving sufficient information to enable anyone to make a rubber sponge.

Inventors who try to keep back part of their invention as a trade secret while getting a patent are playing with fire. In the first infringement suit, their patent may be declared worthless and their protection lost.

Don't leave anything out of your application essential to the invention.

One inventor from Washington carried this fault even farther. He wanted me to get him a patent, but he didn't want to tell me the details of his invention! Not infrequently, a client will ask me if I can tell him whether he can get a patent before he explains all the details of his invention to me. No attorney can do that. He must have all facts about an invention before he can make an accurate search of previous patents in the files of the Patent Office in Washington.

Another frequent source of trouble, after a patent is granted, comes from the use of words that do not have precise definitions. For instance, a few years ago an eastern inventor patented a new method of making "sheer" fabric. When his patent was granted, it proved an immediate "ticket to a lawsuit" because nobody could agree on an exact definition of "sheer." Only after costly litigation was the word defined and the scope of the patent established by the courts. Any term that is ambiguous, vague, or debatable in an application is likely to prove a source of later trouble.

See that only words having precise definitions are used in your application.

At El Dorado, Kans., some years ago, a car repairer named J. S. Hardie worked in the Missouri Pacific shops. One day, while as-



Go over your specifications and drawings many times to be certain they are accurate



Check the draftsman's work carefully to make sure nothing essential is omitted and no errors made



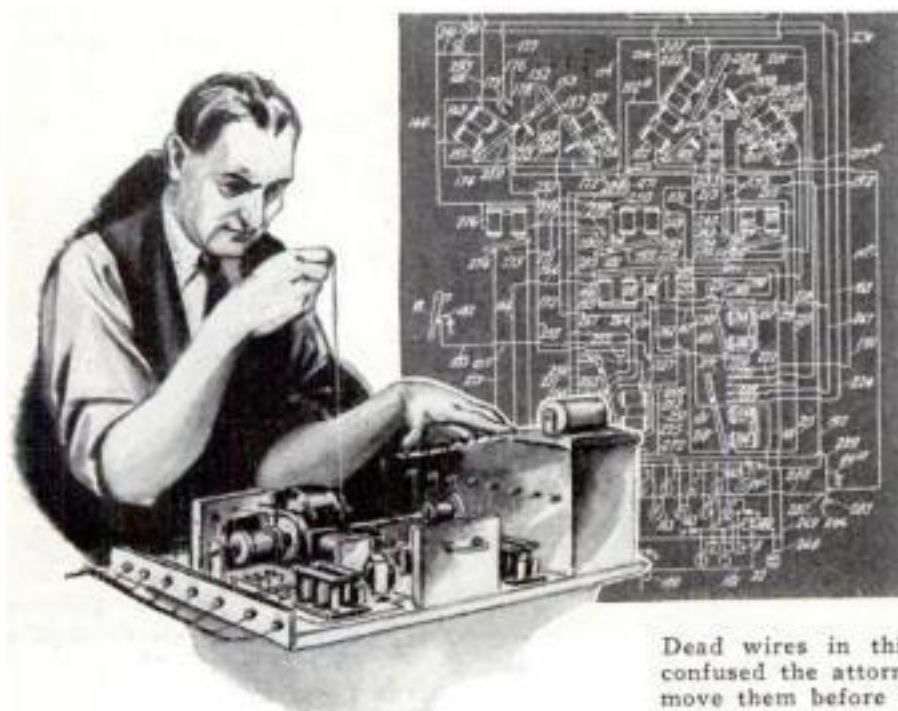
Before showing your invention to a manufacturer, file a patent claim and keep the date of such filing a closely guarded secret

sembling the huge metal trucks and wheels that support freight and passenger cars, he was struck with an idea for making the work easier. He saw that if peculiarly shaped holes were incorporated in the sides of the arches on the truck, the bolster, or crosspiece, with all its fittings could be slipped into place as a single unit instead of requiring assembly a piece at a time. This hole was designed especially for the Shaeffer bolster, then almost universally used.

Hardie sent his drawings to a patent attorney. He was erroneously informed that his application must not show the Shaeffer bolster because that was already patented. As a matter of fact, a large share of all inventions are improvements on devices already patented, and these devices must necessarily appear in the applications in order to indicate the utility or value of the new idea.

Hardie's attorneys replaced the Shaeffer bolster in his drawings with a makeshift crosspiece. It did not have the projecting fittings on it that made the unusual shape of the hole necessary. After the patent was granted, the courts held it void because it did not indicate the use or utility of the invention. With the kind of bolster shown, it was pointed out, the peculiarly-shaped hole, which was the feature of

(Continued on page 123)



Dead wires in this electrical device confused the attorney, who had to remove them before the application was made, as they might have invalidated it

"TRAINED SEALS" are SEA LIONS and They're Smarter than a DOG



Above, sea lion puppies like this one can be picked up with ease at the rookeries but cannot be raised in captivity. Right, "Steady" is the command given this lion during its act



S. C. Charles, the author, knows both sea lions and dogs, and his experience convinces him that sea lions are smarter

I HAD not seen Jimmie for ten years, not since I had trained him with a traveling circus. He had grown and weighed nearly half a ton, too heavy for an "animal act," so he rode comfortably in a tank and got six or seven pounds of fish a day for doing nothing. His occasional deep roars, and short, savage, barks, were considered sufficient performance for him.

Inside the Big Top, I walked over to his cage.

"Hit, Jimmie, hit!" I said.

He came to the rim of the tank, drew himself half out of the water, and peered at me through his great, velvet, brown eyes.

I did not put my hand through the bars. Never try to stroke a wild animal until it shows that it knows you, especially a sea lion, which is as fast as a striking snake, and may bite, not from anger, but through fright or by mistaking the white hand for a fish.

"Hit, Jimmie, hit!" I ordered again.

He lifted himself out of the water, reared back on his hind flippers, and began to clap his front flippers, like a child playing the old game of patty-cake.

"All right, all right," I said.

He stretched his head to the bars. I handed him a bit

of fish, and stroked his black neck. He had not forgotten. Sea lions never forget. They are more intelligent than dogs, just as friendly, learn as rapidly, and do some tricks better, notably playing with fire. I have been training them for nearly twenty years, and even now I am frequently and pleasantly surprised by some new sign of their smartness.

I remember one sea lion I trained several years ago. He was afraid of fire from the start, though he would do other tricks well. After I had gained his complete confidence, I overcame his fear. First, I held freshly charred wood under his nose, without any flame, so he learned that the odor of fire would not hurt him. Then I painted the dumb-bell, baton, ball, and horn he blew a brilliant orange-red, as nearly flame color as I could mix the paints. Thus he learned that the color of fire would not injure him. Thereafter, I accustomed him to heat, by holding an electric foot-warmer near his nose, rewarding him with a piece of fish every time he did not flinch from it. Soon, he was playing with his torch just as perfectly and as fearlessly as if he never had been afraid of it.

WHENEVER you see a "trained seal," you may be certain of two facts: First, that it is not a seal at all, but a sea lion, short-haired, long headed, friendly to man, and very different from the true seal, which is long-haired, short-headed, with a bad disposition, and so dumb that it cannot be taught the simplest tricks. Second, you may know that all trained sea lions come from a narrow strip of Pacific coast, from about Santa Barbara, Calif., on the north, to the southern tip of the Mexican peninsula of Lower California, on the south. Nowhere else in the world are the sea lions so tractable, so intelligent, so easily caught, or so easily trained.





Sea lion puppies on a rookery on one of the Coronado Islands where the gentlest and most intelligent of these animals live

By S. C. CHARLES

Director of Animal Training, San Diego, Calif., Zoo

You will hear many stories of how these sea dogs, as sailors call them, may be approached on their rookeries and even stroked or fed. It is even said that they may be led into cages with a piece of fish, and that the young puppies may be picked up, taken to a zoo or other suitable place, and reared by hand.

AS A matter of fact, one cannot approach close enough to a wild sea lion to stroke it, and if a man did get that near, he would lose his hand when he extended it, for the sea lion is equipped with as good a mouthful of teeth as any dog. Moreover, the cows are dangerous when their puppies are small, and as for rearing a sea lion from puppyhood, I have known of no instance, though I have known of hundreds of attempts. The pups die in a few weeks.

If a sea lion, male or female, is caught when it is two or three years old, it often will become as attached to its master as any well-cared-for dog. Captain G. Allan Hancock, who makes many trips along the coast and to the outlying islands in the interest of scientific investigations, has a sea lion that he has carried with him on his motor yacht for a number of years. This lion, called "Bubbles," has its own tank on board, and also has the freedom of the afterdeck. It is allowed to go swimming overside, where there is a special gangway up and down which it goes. Sometimes it will be absent all day, but returns to the boat before darkness.

A few months ago, while Bubbles was out swimming, a herd of wild sea lions came along. Instantly, the tame sea lion turned and fled back to the yacht, whimpering and crying like a frightened dog. There it dashed up the gangway and into its tank. Since that day, it never has left the boat, and cannot be coaxed into the ocean. Yet the herd of sea lions which it encountered was of the same variety as itself.

Apparently it had learned that safety and security were to be found with its master.

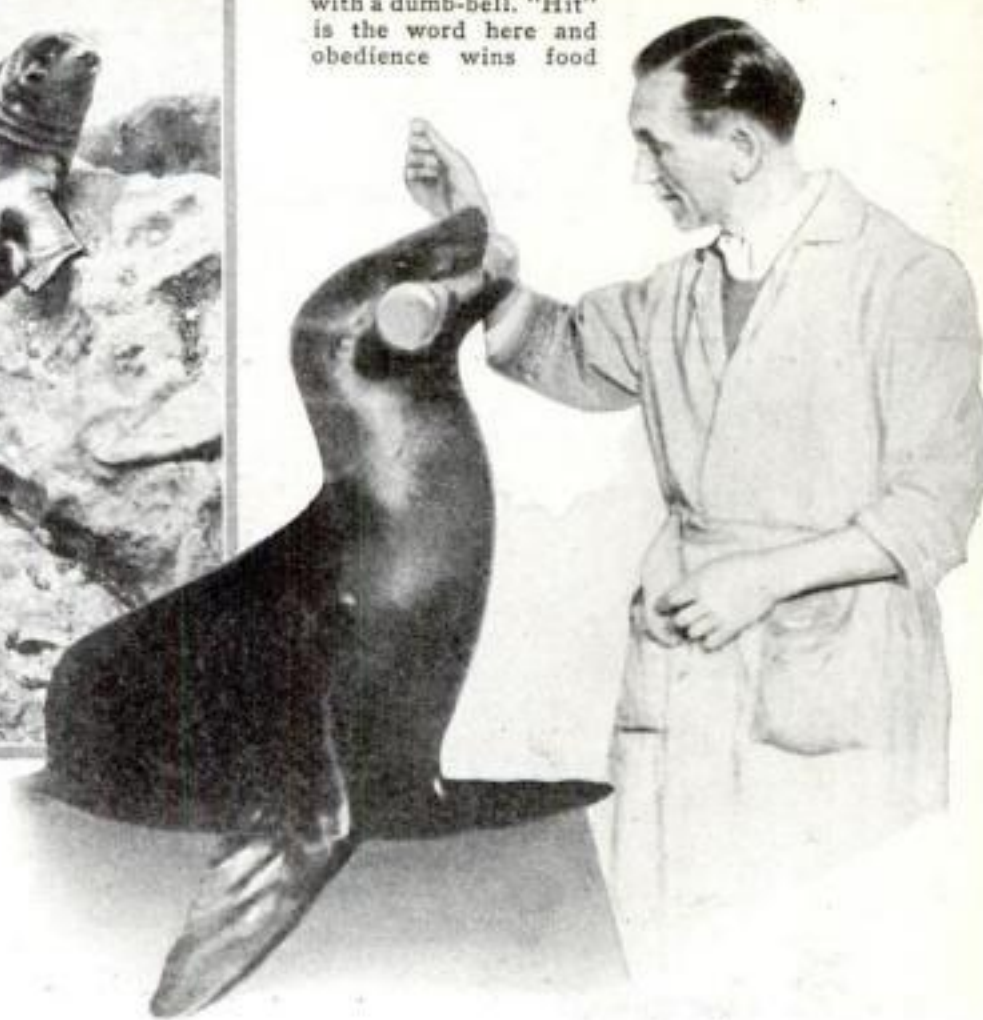
As in the taming and training of other animals, sea lions must be caught before they can be taught. We catch them in triple nets of large mesh, so that, if one layer of net breaks, the second or third will hold. These are stretched across tidal creeks on the inshore islands, and lions, two to four years old, are captured as they try to return to the ocean. We could pick up any number of puppies, from a few days to a few weeks old, on the rookeries, but as I have said, they cannot be reared and we leave them to their mothers' care.

I prefer sea lions two or three years old for training, because they eat more readily, do not have to be fed with a bottle or a spoon, and are less susceptible to diseases. As a rule, they will not eat for some time after they have been captured, some of them fasting for two or three days, and a few for a week or more. Once they take food from their keeper, however, the first third of their training is accomplished. Often we have a score or more of sea lions in the large open-air pool at the San Diego zoo, and from these I have selected eight that I am now training.

THERE is as much difference between individual sea lions in tractability, disposition, and intelligence as there is among dogs, or among men. Some of them, once reconciled to the fact that they are captives, immediately become tame, may be stroked and fed by hand, and will follow the man who feeds them over either land or water.

In fact, the winning of their confidence is the first step in my method of training sea lions. I do this by spending hours, quietly, with them when they are first caught. As soon as they arrive at the pool, I select six or seven that seem the

Below, Charles teaching a sea lion a trick with a dumb-bell. "Hit" is the word here and obedience wins food



most tractable, and remove them to a comfortable tank in a building—for the wise trainer never undertakes to train any animal outdoors. They must be accustomed, from the start, to the interiors of buildings and to the presence of people.

AS I am sitting or standing near this group of selected sea lions, I move slowly, never making a sudden motion with hands, feet, or head. I talk to them constantly, in an ordinary tone, never shouting, never becoming angry, never showing fear, and, above all, never giving them any reason to fear me. I sit on the edge of the tank, or on a stool in the middle of the platform where they rest and roll outside the water, until they become so accustomed to me that they will nudge me with their noses, shove me out of their way, and, at last, begin to bark whenever I appear. Whenever one of them permits me to stroke its head, or becomes otherwise friendly and familiar, it is rewarded immediately with the words, "That's good, that's good," and a piece of fish.

I never vary the instruction or command for any act, nor the words of praise when one of them does well. Gradually they learn to associate certain sounds of my voice with the trick they are to perform, and with the reward for the successful performance of it, words of praise always being accompanied by a bit of fresh fish. While they are in training, they receive no food except what I give them as a reward for good work. This amounts to from three to five pounds of fish a day for each sea lion every day in the week except Sunday, when they receive no food at all.

Since this amount of food is ample for them, stories of the destruction of quantities of fish in the ocean by sea lions evidently are quite false. I am certain that the

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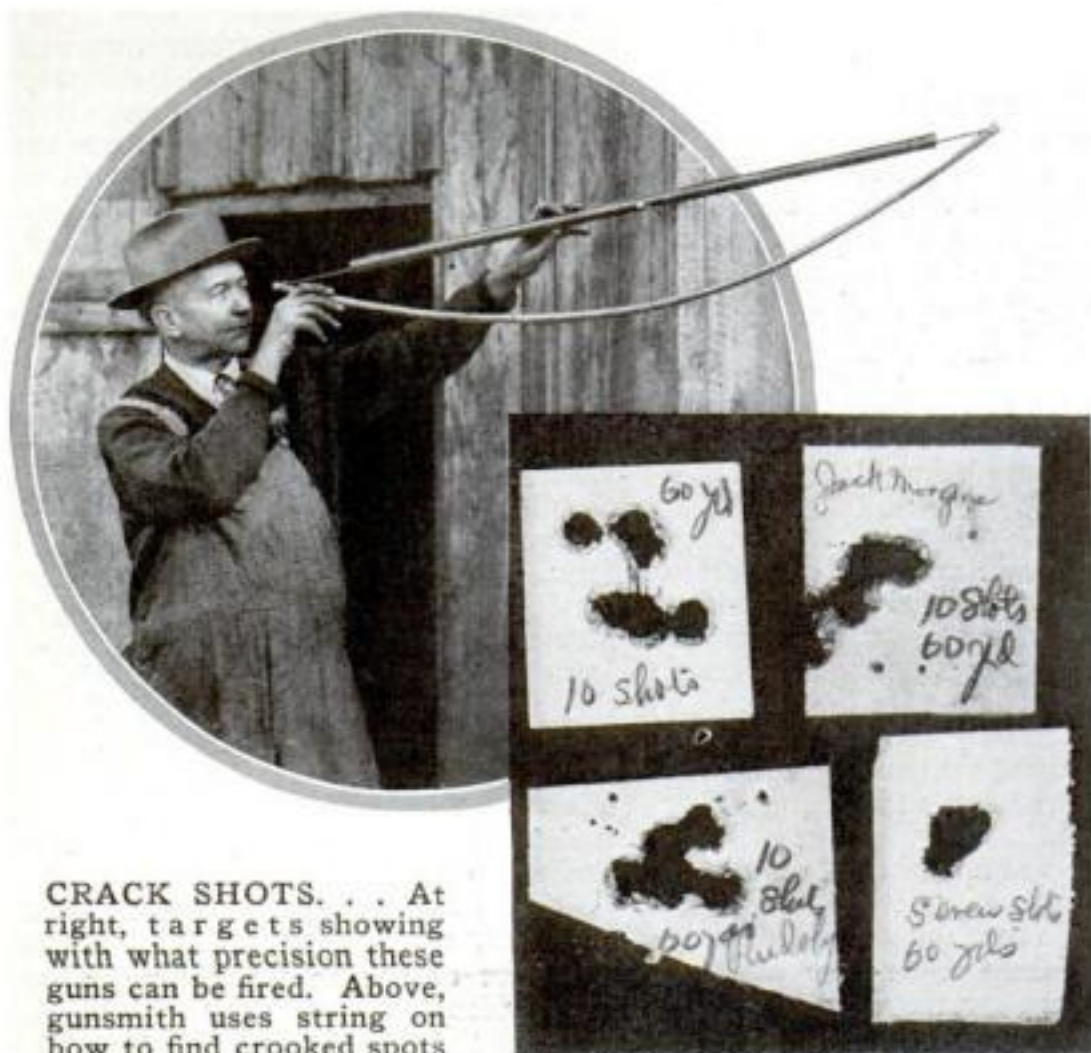
HOMEMADE RIFLES GET ACID TEST

From miles around Tennessee mountaineers meet at the shooting matches to test their skill. Here they are competing, using their pet rifles, each of which was made by hand exactly as they were turned out 100 years ago. Below, one of the hand-wrought rifles finished and ready for use in a match



Daniel Boone RIFLES

STILL MADE BY MOUNTAIN MEN



HIGH in the mountains of Tennessee, a few men still ply a craft handed down from the days of Daniel Boone. They are the makers of muzzle-loading rifles, and the arms these men turn out by hand are the equals for accuracy, within their range, of the best products of modern factories.

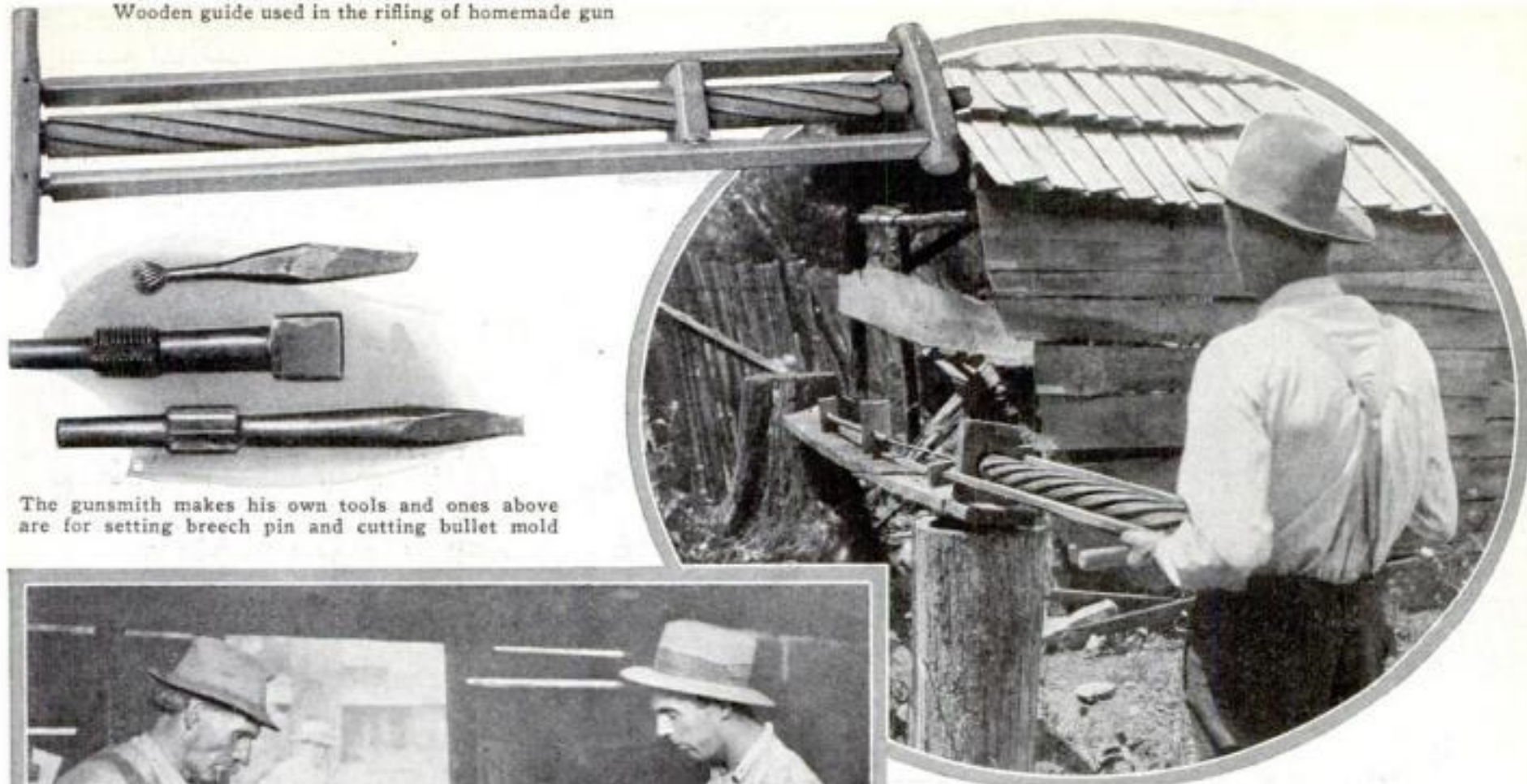
The mountain gunsmith starts with a flat bar of iron. Its edges are turned and welded over an iron rod, an inch or two at a time; a smith can weld a four-foot barrel in half a day. Then it is bored with bits which, like all his tools, he has made himself. Next he stretches a silk thread on a hickory bow through the bore to find where it needs straightening—a delicate task done with a hammer. Finally the bore is rifled, a homemade wooden screw guiding the tool that cuts the spiral grooves.

From miles around, mountaineers ride in on horseback to test their rifles in Saturday afternoon shooting matches. Here the reputation of the maker is made or lost. Each rifleman gets five shots at his target, a piece of wood marked with his name.

It is a deliberate process, for the muzzle-loaders that their owners call by such pet names as "Old Scaley," "Center," and "Long Tom" are not quick-firing. Old-fashioned powder-horns come into play, and the air reeks with the smell of black powder. Finally comes the exciting moment of "measuring the match." So accurate is the shooting that hits must be measured with a pair of dividers.

CRACK SHOTS. . . At right, targets showing with what precision these guns can be fired. Above, gunsmith uses string on bow to find crooked spots

Wooden guide used in the rifling of homemade gun

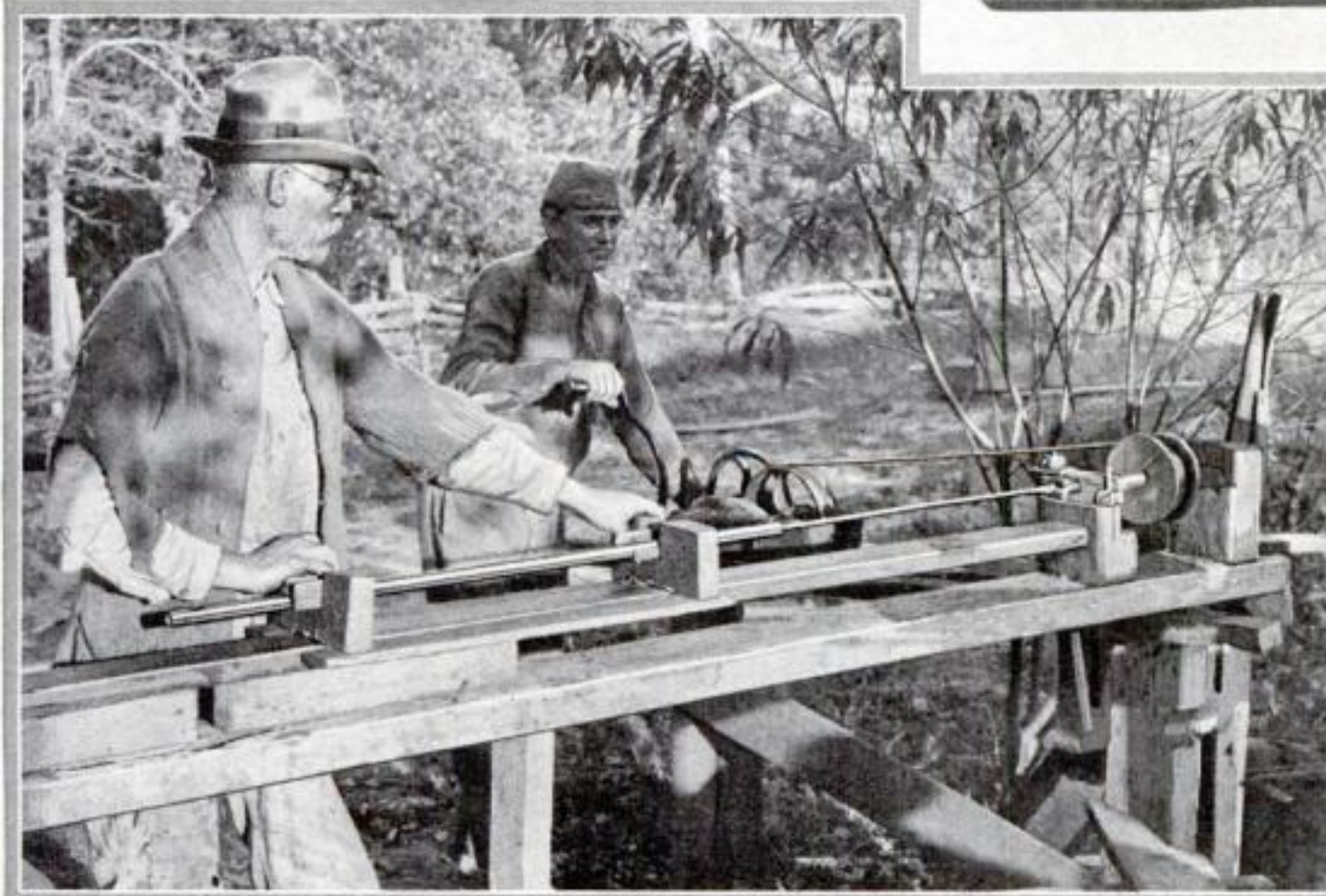
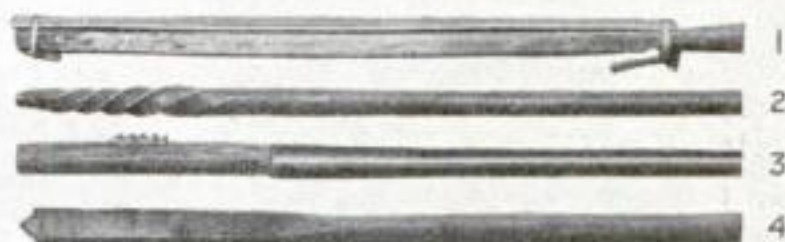


The gunsmith makes his own tools and ones above are for setting breech pin and cutting bullet mold

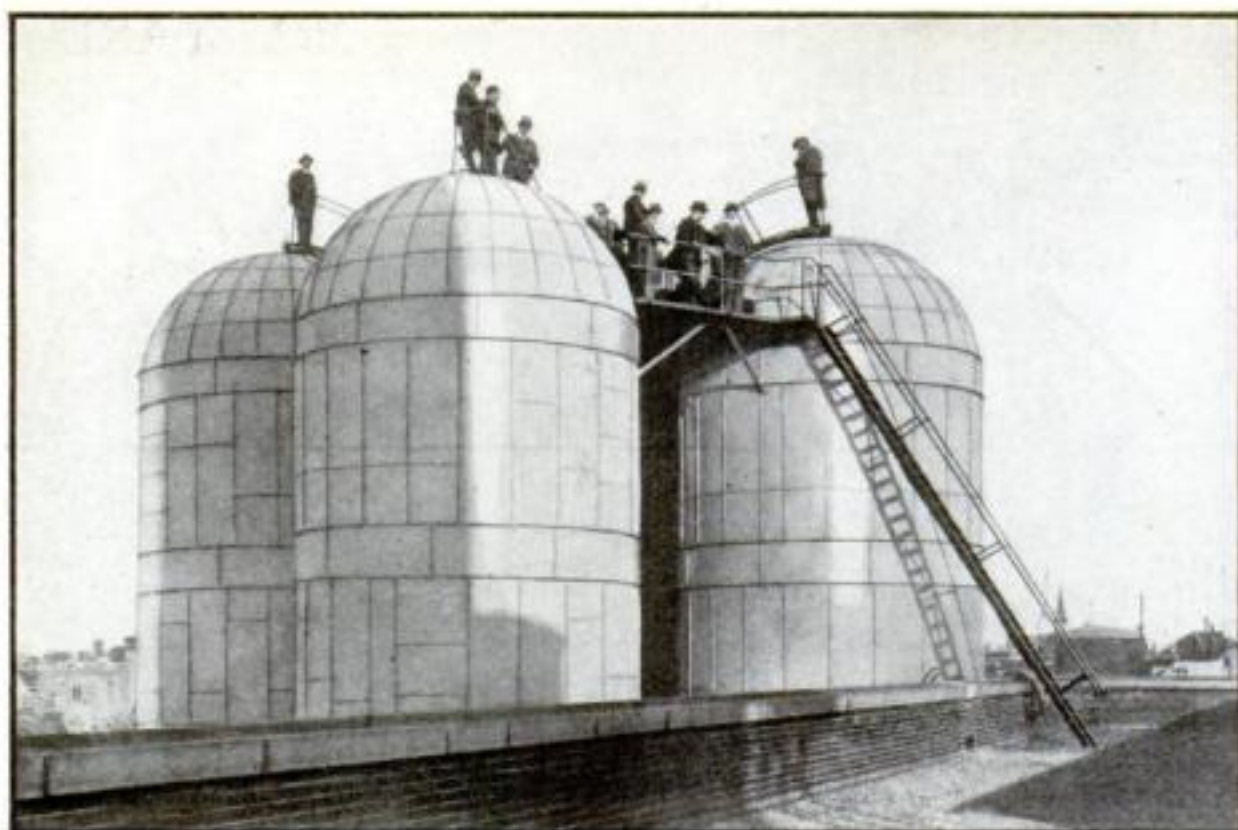


WELDING. . . The mountain gun maker starts with a flat bar of iron, which he hammers around an iron rod held by his assistant, welding only an inch or so at a time. After each weld, the rod is knocked out and moved ahead for the next operation until the barrel is finished

RIFLING. . . Above, the last step in the making of the gun barrel. A spiral-cut piece of wood is used as the guide for the cutter. By pushing the handle back and forth, the smith makes the twisted grooves that insure the accurate flight of the bullet. The cutting edge of the rifling tool is raised as the cut deepens by placing a piece of paper between it and the wooden holder, until the groove has been given the desired depth



BORING. . . At left, after the barrel has been welded, it must be bored and the delicate task of feeding the bit by hand is done by the master himself, as the value of the gun largely depends upon this operation. The apparatus may appear crude but the guns produced have unbelievable accuracy. Above, No. 1, long bit with hickory guard; No. 2, the short bit, the first used. No. 3 and 4, rifling tools



Big reservoir tanks, designed by Swedish inventor, are put in use at a power plant to store up steam when demand is light and save it for use when peak load calls for capacity output

Building blocks made of rubber are noiseless and have no sharp edges to hurt baby



NEW BUILDING BLOCKS ARE MADE OF RUBBER

IF BABY bumps his head upon these new blocks, or they happen to fall upon him, no harm is done—for the blocks are made of rubber. They are washable and noiseless, should they tumble on the floor. Thrown across a room in a moment of youthful exuberance, one of these blocks cannot damage furniture or windows. The blocks are manufactured in various sizes and upon them are stamped the letters of the alphabet. According to the manufacturers of the new building blocks, they contain no injurious dyes or paints and so are harmless if the little architect exercises his jaws on them.

SWIVEL ELECTRIC PLUG KEEPS CORD STRAIGHT

SHORT circuits are prevented and the nuisance of kinked wire ended, it is said, in a new electric plug with a swiveling base. Though it may be turned freely in any direction, the prongs remain firmly fixed in the outlet and current flows without interruption. This swivel plug, according to the manufacturer, is particularly helpful in the use of a flatiron or in the operation of electrical massage apparatus during which a kinking cord may seriously interfere with the work.



This plug for electrical appliances has a swivel joint that turns and keeps cord from kinking

STORE STEAM IN TANKS FOR PEAK LOAD USE

RESERVOIRS of power are the giant tanks at Copenhagen, Denmark, pictured at the left. They were designed by the Swedish inventor, Dr. Johannes Ruths, to store up steam when a power plant produces more than it can use, and save it to carry peak loads when the demand is great. Other countries also have taken up the idea of "steam storage" as a means of equalizing power loads. The tanks, the size of which can be estimated by comparing them with the human figures standing on top of them, are designed to withstand enormous pressure and to maintain, for long periods, the high temperature of the stored steam.

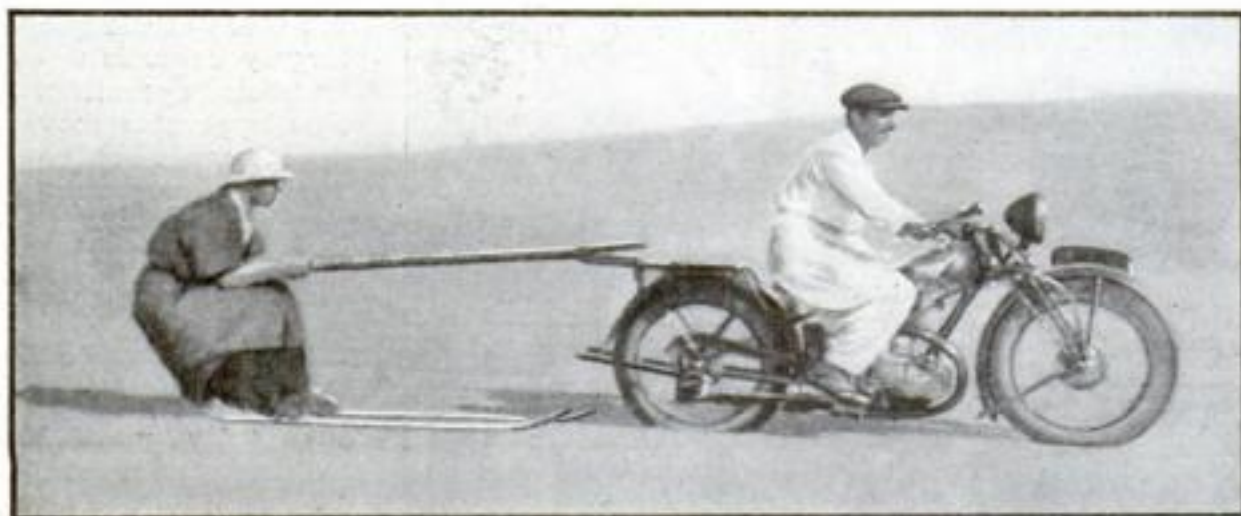


GAME, 700 YEARS OLD RESEMBLED BASEBALL

How old is the game of baseball? Historians trace the evolution of this sport, invented in America, through the English game of "rounders" back into the eighteenth century. But an old stone carving discovered near the Canterbury Cathedral, in England, indicates the possibility of a much earlier origin than has generally been supposed. It dates from the twelfth century, and depicts a Norman boy with a ball and bat, in an attitude suggesting that the Normans played some obscure variant of the American national game.

MOTORBIKE TOWS SKIER ACROSS SAHARA DESERT

TO TALK of skiing across the snowless Sahara Desert might well strain the listener's credulity; yet the photograph at the left shows how a Swiss sportsman recently accomplished the stunt. Taking a tow from a motorcycle, he was able to glide smoothly over the packed sands. He dispensed with the motorcycle's aid in descending the steep sides of sand dunes, where he found he could coast almost as well as if the fine sand had been loose snow.



The packed sand of the Sahara Desert provided the "snow" for this Swiss motor-skier

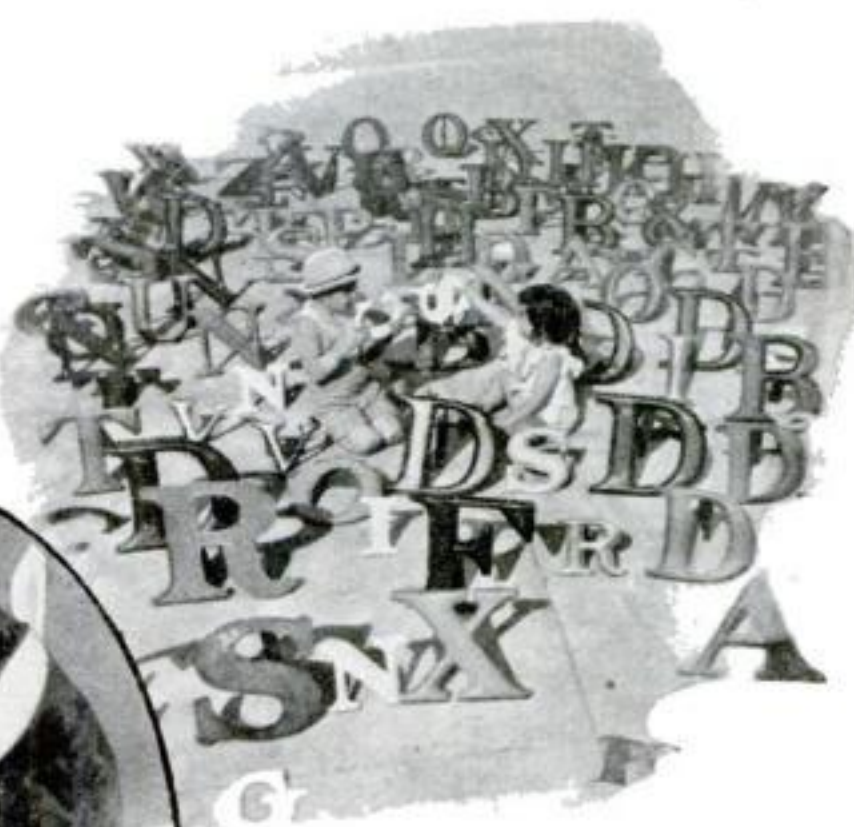


SPOTLIGHT HELPS COP AIM PISTOL AT NIGHT

EASY to aim at night is a pistol equipped with a new attachment, intended for police use. It casts a small spot of light that is visible up to a distance of 250 feet to indicate where the bullet will hit. Within the metal shield is a small flashlight and a set of lenses to focus the beam. The reflector used is of the same type as those in landing lights built into the wings of airplanes. Use of the attachment makes it unnecessary to resort to the usual gun sights in the dark. The device has been patented.

ALPHABET DUMPED IN FACTORY YARD

NEIGHBORHOOD children have found alphabet playthings de luxe in a Vernon, Calif., factory yard. The plant manufactures pressed metal letters for advertising signs, and weathering tests, for which officials use an adjoining yard, were responsible for the unusual scene in the picture at the right.



Letters, made for use in advertising signs, were dumped in the factory yard and found by children who used them as playthings



USE ROBOT PIG TO TEACH FARMERS TO GROW PORK

A LIFE-SIZE mechanical pig, endowed with the power of motion and with tiny electric lights for eyes, is now being used by the Government in teaching farmers how to feed hogs to insure rapid growth and fine pork. The pig, controlled by a tiny motor, picks out the right food from several different kinds offered it.

HARD DRIVING TESTS MOTOR TRUCK

MOTOR trucks get strenuous tests of their ability to withstand rough treatment at a Watford, England, proving ground. The driver sends his machine careening in and out of a pit three feet deep, tak-

ing care to miss none of the bumps. To provide additional punishment, the truck is weighted with a load of steel. The one in this striking picture was carrying four tons. Yet, despite its weight, the daring photographer was able to snap it with some of its six wheels entirely off the ground. Jolted and thrown about, the driver is ready for a rest after completing his day's work.

Click, went the camera as this motor truck, undergoing a strenuous test, hit a deep pit and its front pair of wheels bounced into the air. At the time the truck was loaded with four tons



PHONE MADE PRIVATE BY LOCK ON DIAL

UNAUTHORIZED persons cannot use a dial phone equipped with a handy new lock consisting of a metal cover that clamps firmly over the dial, making it impossible for anyone but the owner of the key to call a number. The device effectively prevents the running up of toll bills in the owner's absence.

At right, using the potter's wheel to restore thousand-year-old Indian jar to its proper shape and size. Below, working on plaster that cements ancient fragments



ANCIENT INDIAN JARS RESTORED WITH USE OF POTTER'S WHEEL

THOUGH only a few fragments may be found on the site of an ancient Indian village, specimens of their pottery can be restored to their original shape through a method devised by Ross P. Wright, of Erie, Pa. The rim and neck of a pot are the first portions that can be identified. When these are found, a clay core is set up on a potter's wheel to represent the interior of the pot. Its size and shape must be guessed; but when the fragments are fitted to the core and revolved, errors may be corrected, a part of a circle giving a clue to the complete circumference. Other fragments are added and cemented on, and gaps bridged with white dental plaster. By this picture puzzle method, Wright and his family have reconstructed sixty-four jars.

SYNTHETIC GRASS LAID ALONG CITY BOULEVARD

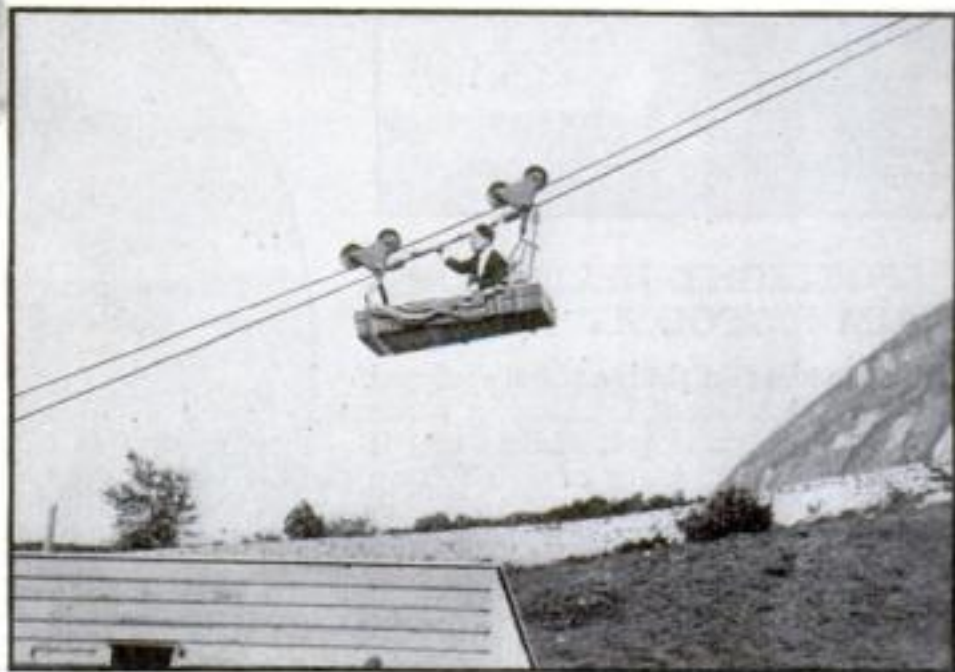
GREEN all the year around, a strip of artificial grass has just been laid beside a New York City boulevard. If the 200-foot experimental plot proves a success, synthetic greens may become increasingly popular in cities. The man-made lawn is unaffected by the carbon monoxide fumes of auto exhausts, never needs cutting, raking, or watering, and does not turn brown in summer. Its appearance fools the eyes of passers-by, for it is said to look more real than genuine grass. This "grass" is a special composition of slate and asphalt on a cinder base.



NEW RUBBER STOCKING GUARDS SILK HOSE

DISFIGUREMENT of silk stockings by rain, mud, snow, and slush now can be prevented, and protection from the cold obtained as well, by means of the sheerest of half-length rubber stockings made of liquid latex, the purest of rubber. When not being worn, the guards fold into a small purse for the pocketbook. They are the result of a new curing process and newly perfected machinery.

At right, aerial railway in France that carries one passenger at a time up a 2,600-foot mountain, making trip in 10 minutes



Below, an outdoor water heating unit designed to keep garden pools from freezing. It burns kerosene and heats water in its coil of pipes seen in photo



OUTDOOR HEATER KEEPS GARDEN POOL WARM

GARDEN pools need no longer freeze even in zero weather, according to the claims of the manufacturer of a recent outdoor heater. The device, which burns kerosene, consuming little of the cheap fuel, consists of the burner and a coil of pipes through which water circulates and is heated. The pipes transfer this heat to the water in the pool, thus preventing freezing and the harm to fish and basin that may be caused by severe temperatures. The economy of its operation, it is said, makes it a real money-saver.

AERIAL RAILROAD TAKES ONLY ONE AT A TIME

ONE passenger at a time is the capacity of a novel aerial railroad just opened in France. It conveys travelers from the little town of Bossey-Veyrier, on the Swiss frontier, to the summit of Mont Saleve, 2,600 feet higher, in about ten minutes.

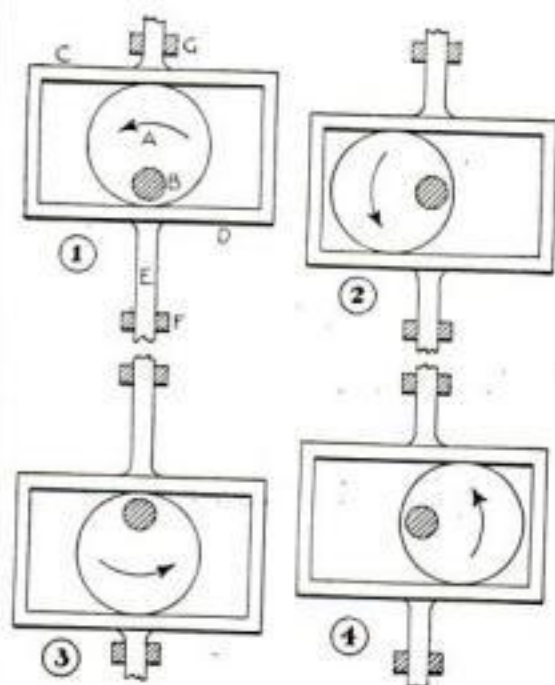
KEY TO ARCH SUPPORT FITS IT TO ANY FOOT

A FEW turns of a key adjust a new arch support, devised by a Chicago inventor. At the end of the day, when people with weak arches grow tired, the support may be turned up or down to give relief without need of removing the shoe. By this means, also, the device, it is claimed, accommodates itself perfectly to any individual's foot.



With this key, a recently invented arch support can be adjusted from the outside to fit the foot

Can You Invent It?

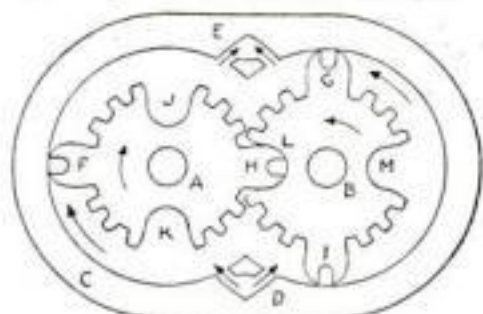


HERE is a circular cam *A*, keyed to a shaft *B*, and rotating with it in the direction shown by the arrows. Embracing the cam and in sliding contact with it are two parallel bars *C* and *D*, which are joined with each other and with the valve rod *E*, sliding up and down in the bearings *F* and *G*. As the cam revolves, the valve rod is carried through a reciprocating motion. The valve port it operates will remain open or closed only for the instantaneous periods when the cam is passing through positions 1 and 3.

Suppose you are required to modify this motion so that the valve will remain fully closed during one sixth of the cam's revolution and fully open during another sixth. The remaining two thirds of the cam's revolution is left free to use in opening and closing the valve port by the up and down motion of the rod *E*.

How would you alter the shape of the cam *A*, and its position upon the shaft *B*, in order to accomplish the desired motions and periods of rest for the valve rod *E*?

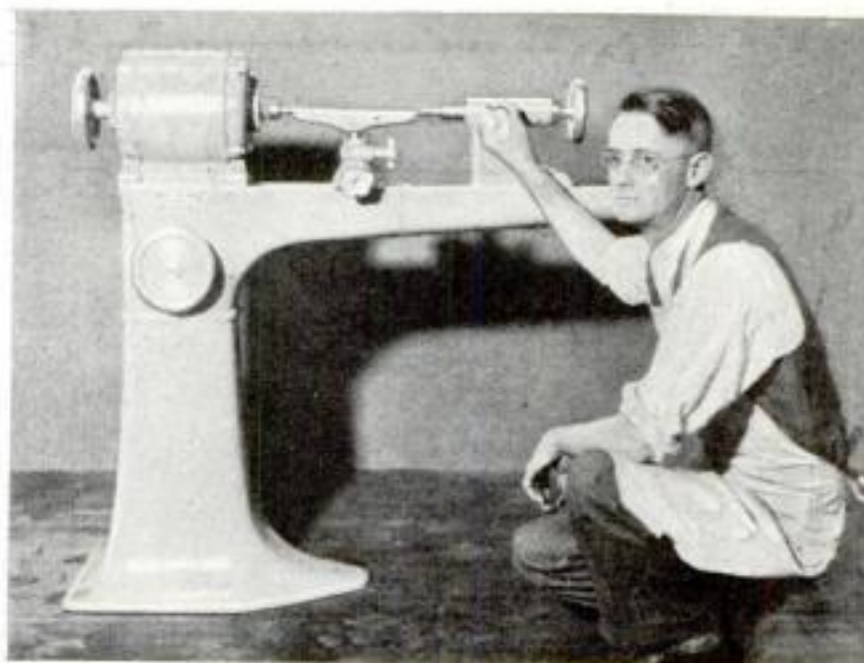
The diagram below shows the correct solution of the rotary steam engine problem of last month.



Notice how the projecting teeth *H* and *F* and grooves *J*, *K*, *L*, and *M* are added

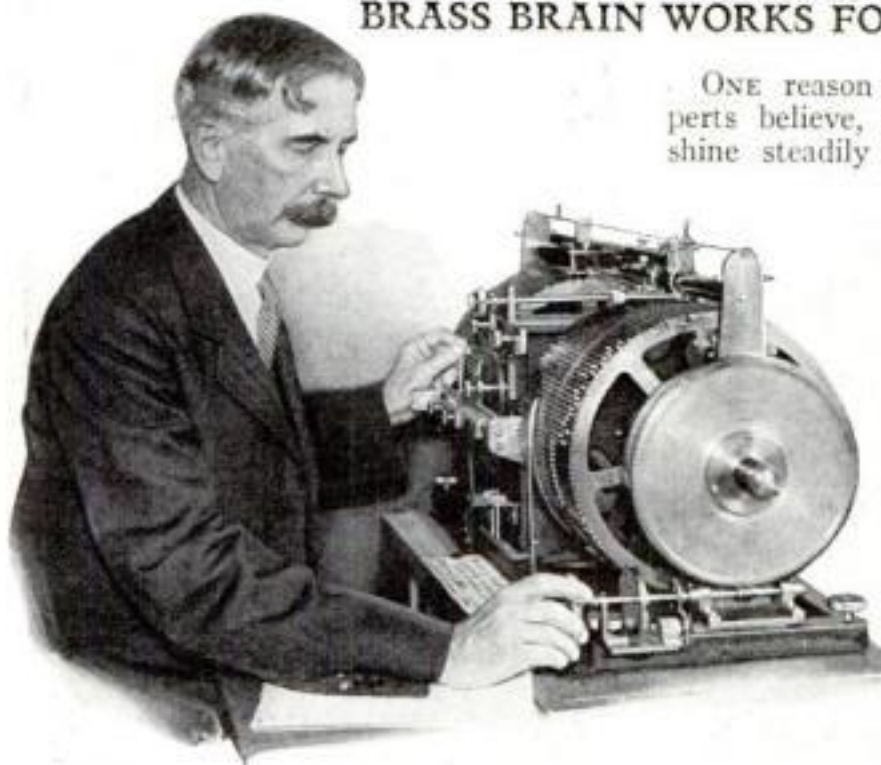
COMPACT LATHE RESTS ON PEDESTAL

STUDENTS in the engineering department of the University of Minnesota recently built this novel type of wood lathe designed by Professor W. H. Richards. Instead of the conventional four legs, Richards' new lathe is supported on a sturdy single column. He maintains that this construction saves so much space that ten lathes will go in the space occupied by eight wood-turning lathes of conventional four-legged design. The new lathe can be built either for electric or belt drive.



An assistant of W. H. Richards, professor of mechanical engineering, University of Minnesota, demonstrates pedestal lathe

BRASS BRAIN WORKS FOR WEATHER MAN



ONE reason the weather changes, experts believe, is that the sun does not shine steadily upon the earth. Careful measurements during recent years show the solar radiation reaching the earth daily, and now Dr. Charles G. Abbot, secretary of the Smithsonian Institution, has devised a "brass brain" which he is using in the photo to analyze this data. The device will reveal the elapsed time between recurring cycles of sunshine. This may lead to long-distance weather forecasts.

AIR PHOTOS AID PALESTINE EXPLORERS

A CAPTIVE balloon and an electrically-operated camera saved archeologists of the University of Chicago untold labor in exploring the streets of the ancient city of Armageddon, in central Palestine. With this equipment they obtained aerial photos that led to such discoveries as an ancient water supply system. When photographs were to be made, the balloon was sent up on a reel of cable with the camera attached. When it had drifted over the spot to be pictured, an electric impulse from the ground operated the shutter.



Above, the captive balloon and camera used by archeologists in making explorations in Palestine. At left, air photo taken by means of balloon

RADIO ROBOT PICKS PROGRAM FOR YOU



BROADCAST receiver, clock, and program selector are combined in an attractive new radio set that permits you to select your entire day's or evening's radio program in advance. When the controls have been set to the desired stations, this robot then tunes in the proper station at the selected time without further attention. With a maximum of six stations to choose from, a good variety of entertainment is assured. The device will govern the radio without human intervention for as long as twelve hours.

USE FIVE-LENS CAMERA IN MAKING AIR MAP

AN AREA of 3,600 square miles in Maine was photographed in three hours from an Army plane recently by use of a five-lens camera invented by Major J. W. Bagley, of the Corps of Engineers, U. S. Army, and developed by the Army Air Corps at Wright Field. The camera has four lenses grouped around a central vertical lens that photographs country immediately beneath the plane. Fields of vision of the side lenses cross each other at a point just below the camera. Since the lenses of this camera are set at wide angles, films, before being printed, must be corrected for distortion. This is done on a machine specially developed for this camera. As a result, the finished picture is in the form of a Maltese cross.



This tiny flashlight is tucked away in the key case and used when unlocking door in dark

ANTI GLARE SHIELD IN NEW HEADLIGHT BULB

PROOF against glare, according to the maker, is a new type of automobile headlight bulb just invented. A tiny shield of metal is inserted in the inside of the lamp, just beneath and ahead of the filament. The rays are therefore prevented from striking the bottom side of the headlamp reflector, which ordinarily causes glare, and direct rays are also shielded from the eyes of oncoming motorists. The inventor of the bulb also claims that its light will penetrate fog and that the diffusion of rays clearly illumines objects at a distance from the car. In picture above the bulb at right is the new non-glare type.

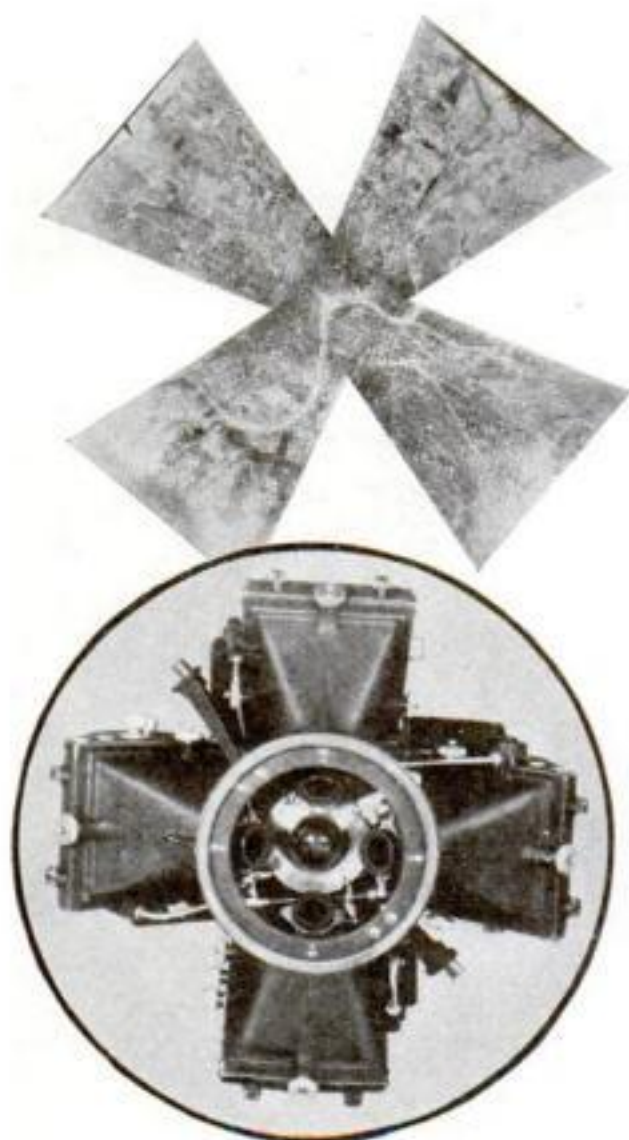
TINY FLASHLIGHT IS FITTED IN KEY CASE

THE user of the novel key case illustrated at the left never has any difficulty in finding the keyhole at night. Besides keys, the case contains a tiny flashlight that responds to the touch of a thumb by throwing a spot of light on the door. It could also be used to find dropped articles in a darkened theater. Lens and battery are so small that the entire outfit occupies little room in hand bag or pocket.

DIALING A NUMBER GIVES STOCK PRICE

MERELY by dialing a number, a broker may now learn at once the prices for the day of any one of the 1,286 stocks listed on the New York Stock Exchange. This is accomplished through a new machine known as a "teleregister," designed to supplement or replace stock tickers in brokers'

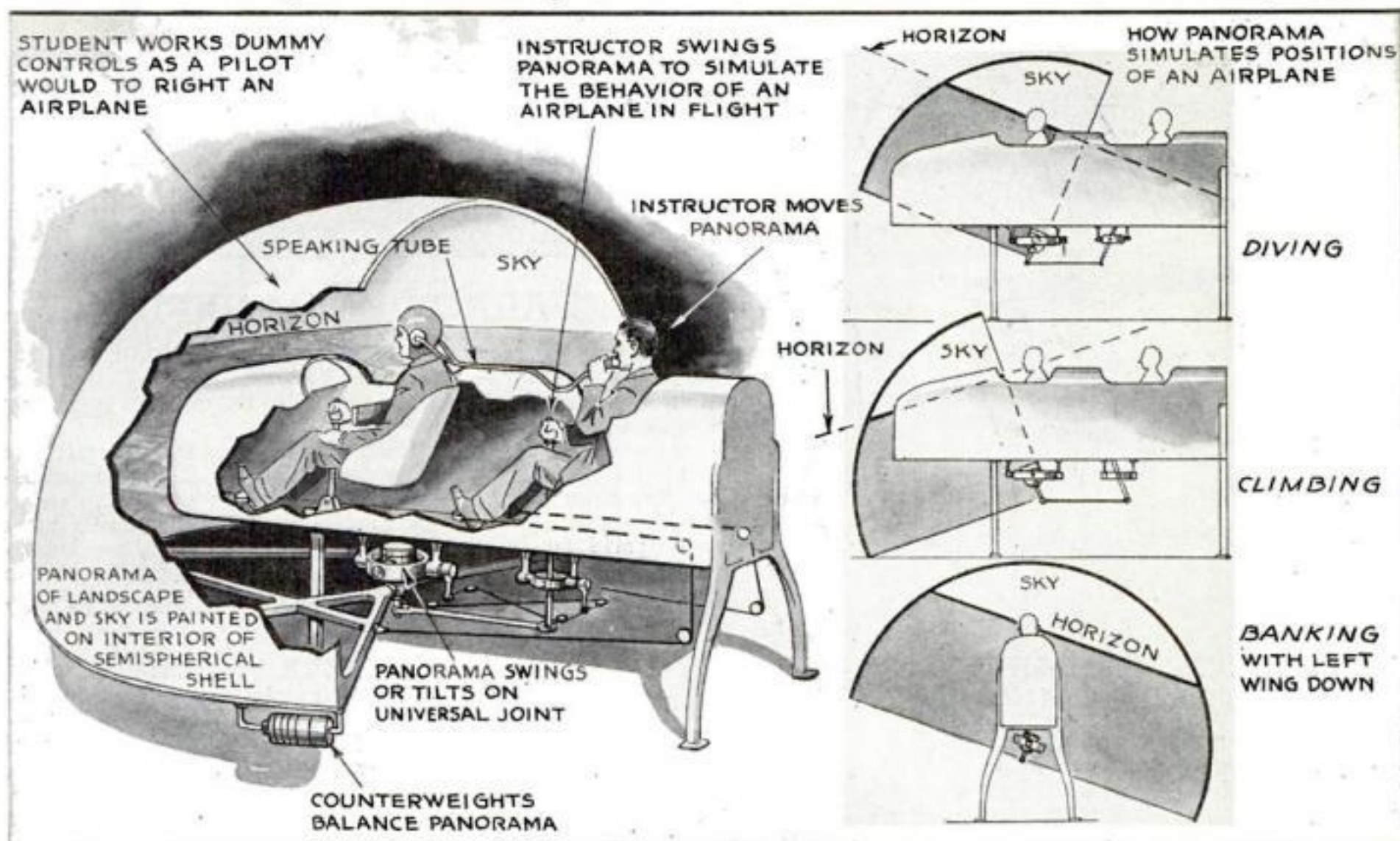
offices. In response to the dialing of a stock's assigned number, windows in an indicating panel reveal the opening, high, low, and last prices for the day. The number of the stock also appears on the board to preclude any errors that might be caused by incorrect dialing.



At top, film from aerial camera printed in shape of Maltese cross. Above, five-lens camera used in making maps from a plane



Landscape, Rocked by Instructor, Teaches Student to Fly



Drawing of rocking panorama shows how it is used in teaching student pilots to keep plane on level keel

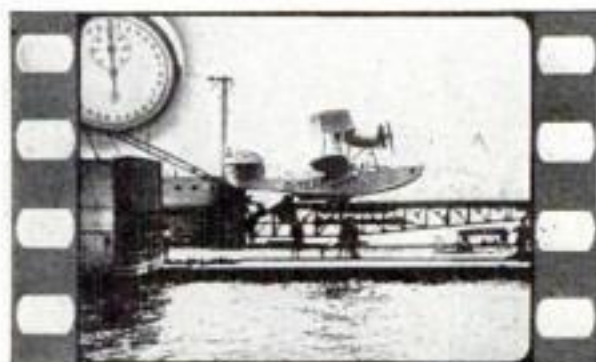
THE principle of relativity that makes a railway passenger feel his train is moving out of the station, when another train backs beside it, has been applied by a New York City inventor in an ingenious device for teaching would-be pilots to fly. Student and instructor sit in a stationary model of an airplane fuselage. A semispherical shell, painted with a landscape and tilted or shifted by the instructor, gives the student

the sensations of actual movement in the air. Without leaving the ground, he becomes familiar with rolls, pitches, and yaws and other sensations of flight.

Levers similar to the rudder bar and "joy stick" of an airplane enable the instructor, sitting in the rear seat, to tip the panorama forward, backward, or from side to side. With each maneuver the student is required to manipulate controls

in such a way as to right the imaginary plane. By watching the student's actions, the instructor detects his faults. According to Henry J. White, the inventor, one way of doing this is to wire the instructor's controls in reverse. Then when the instructor tips the imaginary airplane with one of his controls, the novice should make exactly the same motion with his controls to right it.

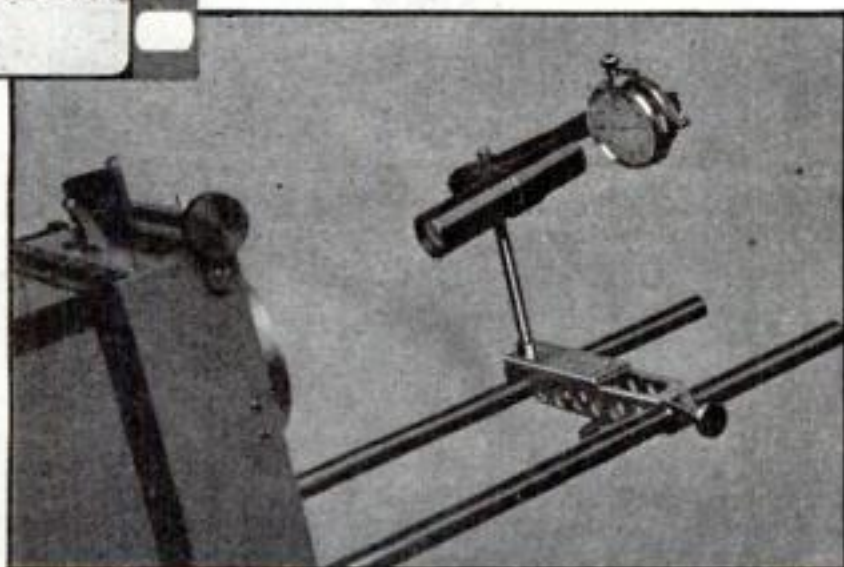
CAMERA FILMS WATCH TO TIME RACES



The image of the stop watch appears on the developed film, giving the speed data

SPEED tests of moving vehicles, and sporting events such as races, are now accurately timed by photography through a device developed in Germany. This consists of an attachment for an ordinary motion picture camera, comprising a stop watch and a small telescope to compensate for the difference in focus

between so near an object and the scene behind it. When an airplane's take-off, for example, is to be timed, the stop watch is set in motion and the event is filmed. In the finished print, the image of the stop watch appears on each frame of the film, leaving no room for dispute as to the airplane's performance.



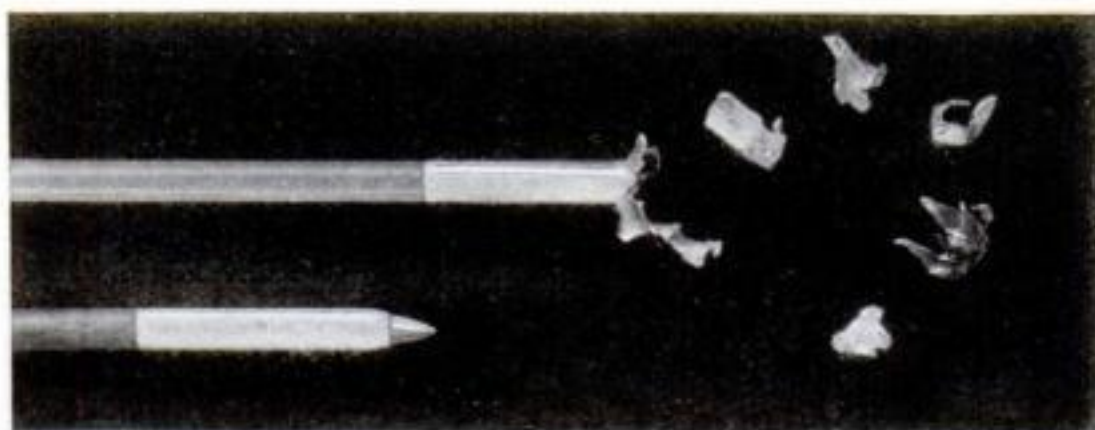
Stop watch and telescope as used in connection with a motion picture camera in the accurate photographic timing of events



FACE POWDER PUT ON WITH AN ATOMIZER

NEWEST aid to quick make-up is the "powder atomizer." Patterned after devices that spray perfume, a squeeze of its bulb is said to distribute a fine coating of face powder exactly where it is needed. When the user applies a few hurried, last-minute touches just before going out, the muss of handling loose powder is avoided. A big reservoir makes refills infrequent.

Below, shooting an arrow equipped with an explosive point to kill big game. At right, fragments of exploded head and an unexploded point



BIG GAME ARROWHEAD EXPLODES

AN EXPLOSIVE arrowhead for hunting big game has been perfected by an Oakland, Calif., archer. It is as easily attached to any arrow as the ordinary point, and is said to be as effective in bringing down a wild animal as a high-powered rifle. This new missile for the archer is declared more humane than the ordinary arrow, since

it is more likely to kill instantly. Even if the arrow does not strike a vital spot, a jagged particle of the exploded point may do so.

The head is equipped with an automatic safety device that prevents accidental explosion. There is also a removable stop that renders the tip nonexplosive when desired, for target practice, so that an archer may familiarize himself with the flight of arrows tipped with these points.

NEW MICROMETER CAN BE USED WITH ONE HAND

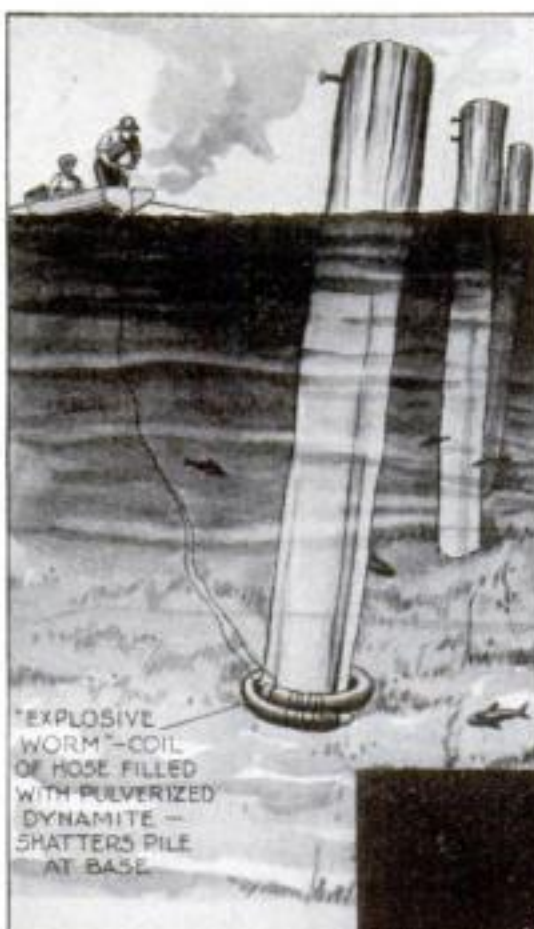
SO THAT a micrometer will not be screwed too tight to throw out the thousandth-of-an-inch precision with which it measures objects, most instruments are equipped with a projecting "thimble" for a fine adjustment. When this is turned it automatically allows the jaws to slip after the proper pressure is reached. The latest type of micrometer, however, has a built-in "thimble" at the end of the handle. Because of this arrangement it may be used conveniently with one hand.



The built-in thimble at end of this micrometer handle makes it easy to use it with one hand

EMERGENCY HAND SOAP NEEDS NO WATER

A CHEMIST for a Kansas City paint company has evolved a secret formula for waterless soap. The soap, in the form of a paste, is harmless to the skin, it is claimed, and even possesses healing and antiseptic qualities. It is designed especially for motorists and mechanics. All the motorist need do is moisten his hands with the soap and then rub it off on rag or paper. It lathers freely without water and absorbs all dirt. It is described as an emergency hand soap.



An explosive "worm," made of rubber hose filled with pulverized dynamite, is used to clip off old piles in Michigan harbor

RUSSIA GETS MODEL SKY

LATEST city to get a planetarium, or model universe, with moving pencils of light to represent the sun and stars, is Moscow, Russia. A photographer snapped the striking picture at the right as men toiled on the framework of the globe-shaped structure where the movements of celestial bodies will be speeded for spectators.



Latest planetarium, with moving pencils of light to represent sun and stars, is built in Moscow, Russia

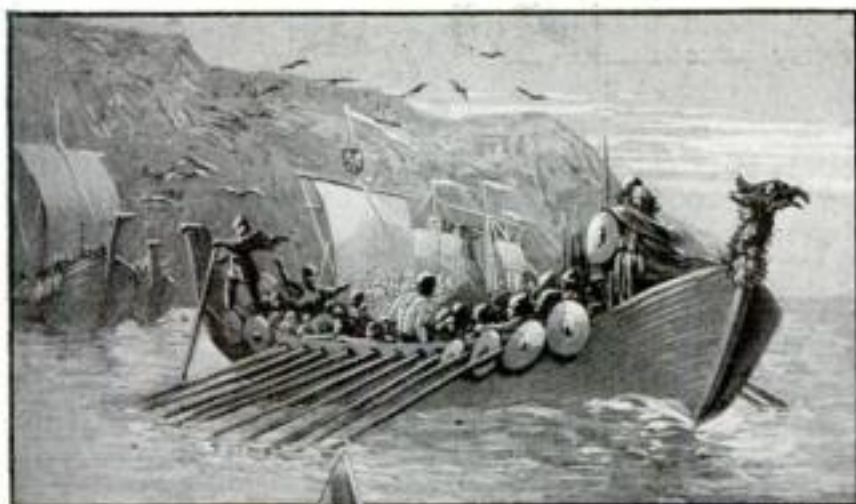
EXPLOSIVE "WORMS" CLIP OFF OLD HARBOR PILES

TO SOLVE the problem of removing old piles from a harbor bottom at small expense, a resourceful St. Ignace, Mich., marine engineer, Viggo J. Thomsen, devised "explosive worms." These consist of lengths of ordinary garden hose closed at each end by wooden plugs and filled with pulverized dynamite. An electrical percussion cap is also inserted at one end of each "worm," and attached to wires. To remove a pile, a "worm" is looped over the head and lowered gently to the bottom. When the wires are carried to a safe place and the charge set off, the pile is sheared off at the bottom as neatly as with a knife. Removal of the piles by ordinary and less spectacular methods would require the aid of a powerful hoist on a scow or a large boat and take longer.

Lucky FIGUREHEADS

for Autos

COPIED FROM
ANCIENT SHIPS



This Viking figure-head ornamented the prow of Eric the Red's ship that brought over the first Norsemen to Greenland



Above, Chinese pheasant as designed for an American car. At right, ancient Egyptian boat that carried a figure to propitiate the god Kaa

IS THE ornament on your car's radiator cap fashioned from bronze or gold? If so, fear no collisions nor motor trouble. The gods that prevent such things will ride with you and protect you wherever you drive!

Superstition, of course. But this is simply a modernized version of the firm faith that Greeks and Romans once placed in similar figureheads adorning their boats and chariots. By tracing back the ancestry of the modern radiator cap ornament directly to such early figures, a California craftsman has revealed a fascinating bit of untold lore, and, applying the fruits of his research, has developed a unique and profitable business.

While Neal Tanquary, of Los Angeles, Calif., was touring Europe some years ago, a Paris automobile accessory man mentioned to him that American radiator cap ornaments were machine-made, and lacked individuality. The chance remark started Tanquary on a one-man search to find the truth behind the radiator ornament. Dusty volumes in library stacks and odd bits of information helped piece it together.

In the earliest hieroglyphic inscriptions of the Egyptians, Tanquary found scribes depicting boats of their rulers, on the river Nile, with a symbolical figure at each prow. This carefully carved image was supposed to furnish abode for the master's *Kaa*, or protecting spirit. To make



At left, Neal Tanquary, Los Angeles, who finds it profitable to carry on an old tradition and make figureheads for cars. Above, one of his reproductions of the sun worshipper "Messenger" adapted for use on car

it attractive to the *Kaa*, it was usually fashioned of bronze, and sometimes of gold.

Ancient mariners, with their fragile ships and crude instruments, must also have had sore need of protecting spirits, for bronze figureheads appear again on Greek and Roman ships, and later on those of the Vikings. On land, similar figureheads decorated the pleasure and war chariots of Phoenician and Syrian nobles. The art of making these images was the cause of great rivalry among some of the ancient guilds.

Determined to carry on the almost-forgotten tradition of the ancient figurehead makers, Tanquary went to Syria, Egypt, India, and China in search of inspiration for appropriate designs, especially those suggesting motion.

A pillar flanking a celebrated tomb near Luxor, Egypt, furnished one—a Sun Worshipers' conception of a winged messenger. Mythology yielded other designs, such as a figure of Pegasus, a winged horse; Daphne, the girl who outran Apollo; and Icarus, the mythical Greek who burned his homemade wings when he flew too near the sun. For some designs he chose figures of animals or birds intended to symbolize the owner, such as a butterfly, a pheasant, or a swallow.

Returning to America, Tanquary found that machine methods were not adapted to such intricate designs. To manufacture them, he has developed a hand method closely resembling that of the ancient guilds. He first creates the figure in wax or clay. This is divided into sections, if the shape of the figure is such that it cannot be cast in one piece. Each section is used in making a mold in which the metal is cast.

Bronze, the material chosen, not only follows tradition but also best withstands shocks of the road. After casting, the parts are shaped and tooled by hand and welded into a solid unit. The seams are tooled out, and the figure is plated with chromium, silver, or gold.



Above, a bronze figurehead depicting Icarus. At right, a radiator cap fashioned after Pegasus, winged horse



The radiator cap ornaments are made by hand in sections and then assembled as at right

TEACHER INVENTS LINOTYPE KEYBOARD



ANYONE who can operate a typewriter can use a new linotype keyboard recently invented by a high school teacher of Fullerton, Calif. This portable machine, called a "typewriter," weighs thirty pounds and fits snugly on intertype or linotype keyboards. A plug screwed into the ordinary light socket furnishes the electricity. The touch with which this keyboard is operated resembles that used on the typewriter, which is entirely different from that learned by linotype operators.



TIGHTENING BOLT NUT CUTS HOLE IN METAL

A NOVEL tool for cutting holes in metal is intended especially for such troublesome jobs as the installation of an automobile hot water heater, where a round opening must be made for the hose. When a small hole has first been tapped at the proper place, the bolt is inserted and the nut tightened. As pressure is applied, a sharp cutting edge bites out the hole. The cutter is made in several sizes. One advantage is that a perfect fit is secured.

NEW CANDLE BURNS OIL

NO MATTER how long it may burn, the candle illustrated here never gets any shorter. Its secret is a reservoir for kerosene, holding enough fuel to burn for twelve hours at a filling. The candle is both decorative and useful as an emergency household light. It has the artistic appearance of a real candle but avoids the dripping of wax on furniture and rugs and requires no snuffing.



This looks like a real candle but, as shown, its fuel is kerosene burned through a wick



WARNS OF A LANDSLIDE

A GERMAN instrument-maker has designed a pocket device to warn mountain climbers of possible danger from avalanches. When the user sights up or down the slope along the edge of a card graduated in degrees of angle, shown above, a pendulum indicates steepness of the hill and consequent risk of a slide.



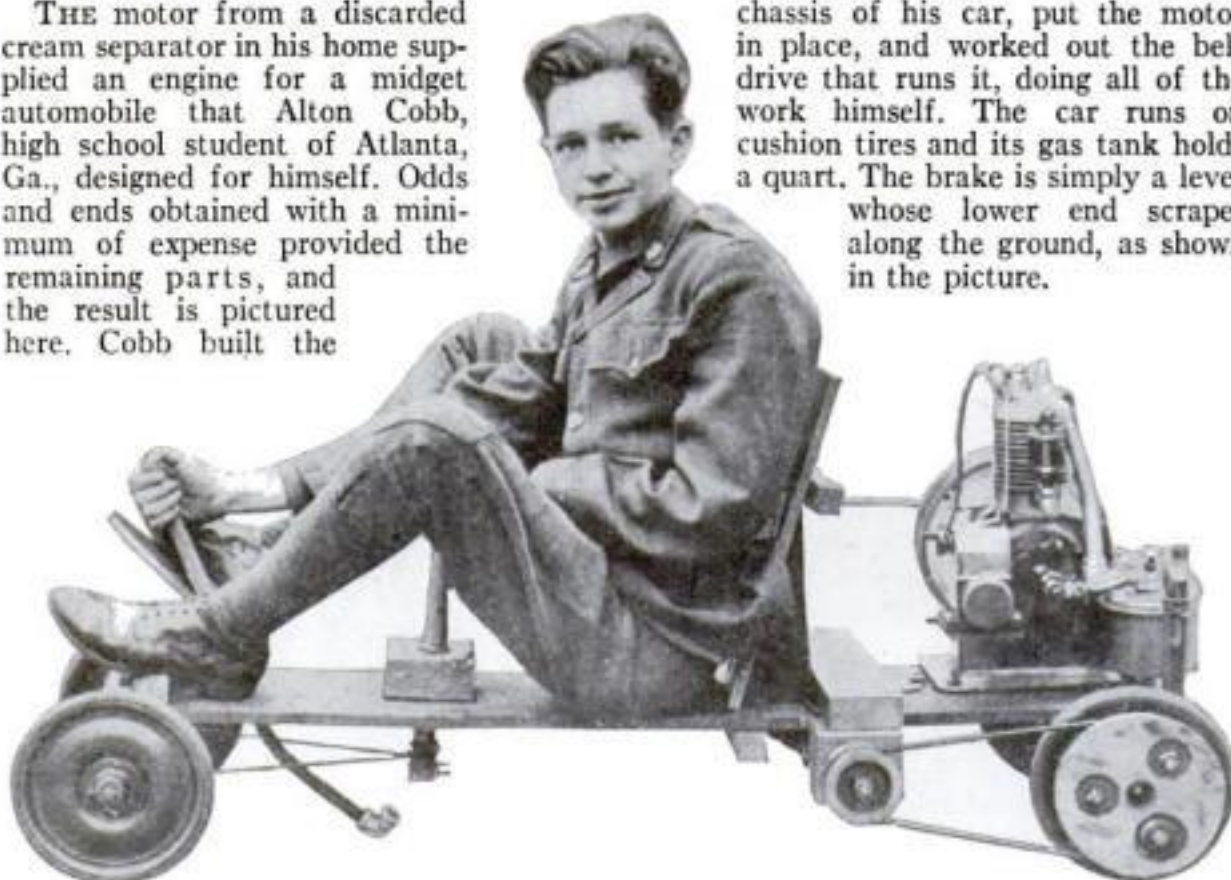
LEMON JUICE IS NOW REDUCED TO POWDER

LEMON juice in powdered form for making pies, icing, and lemonade is a novelty that has appeared on the market. In its manufacture, practically all the water is removed from the juice of ripe lemons. Corn syrup is added to assist in the drying, but it is said not to affect the flavor in any way. According to the maker, the powder duplicates the taste of natural lemons, but the trouble and muss of squeezing them is avoided and the powder can always be kept handy in the pantry for instant use.

CREAM SEPARATOR ENGINE RUNS AUTO

THE motor from a discarded cream separator in his home supplied an engine for a midget automobile that Alton Cobb, high school student of Atlanta, Ga., designed for himself. Odds and ends obtained with a minimum of expense provided the remaining parts, and the result is pictured here. Cobb built the

chassis of his car, put the motor in place, and worked out the belt drive that runs it, doing all of the work himself. The car runs on cushion tires and its gas tank holds a quart. The brake is simply a lever whose lower end scrapes along the ground, as shown in the picture.



Experiments *for* Home Chemists

Fascinating Oxygen Tests You Can Carry Out in Your Own Laboratory

By
RAYMOND B. WAILES



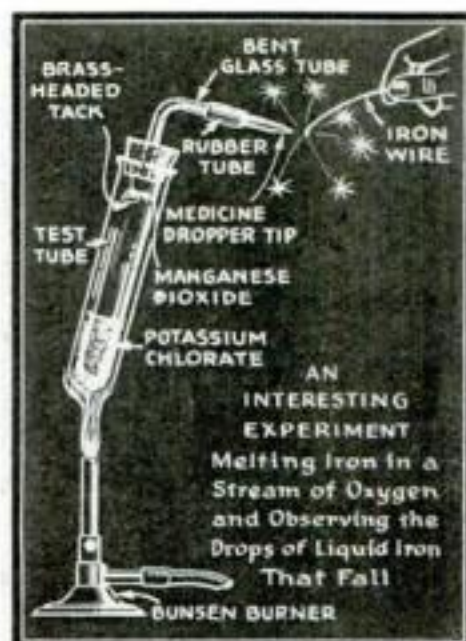
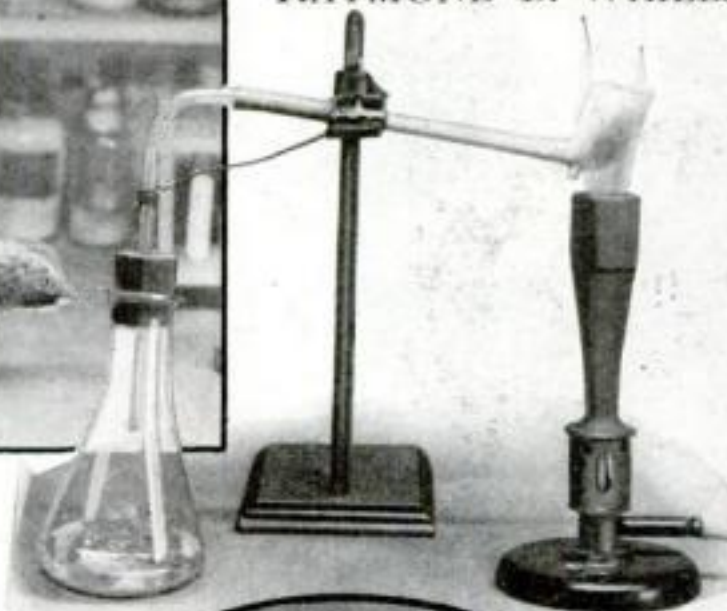
Steel wool can be ignited and be made to burn brightly by blowing on it. Right, hydrogen gas generated in the flask will reduce oxides, heated in pipe, to metals

PERHAPS the most fascinating experiments that the home chemist can perform are those in which oxygen is added to or taken from substances. Such oxidation and reduction experiments are usually accompanied by the production of heat and light, or require heat to bring about their transformation.

The simplest experiment in oxidation is to light a match, but just try lighting a piece of iron instead! Indeed this is possible, for a lighted match applied to steel wool, which is iron modified by the addition of other metals, will cause the fine iron slivers to become red-hot and burn. The oxidation or burning will be especially brilliant if you blow on the glowing iron. It will flare up with such an intensity as to cause the little fibers of iron to melt and roll up into a ball. Fastened on the end of a wire and whirled through the air, the effect is more spectacular.

If pure oxygen is allowed to play upon red-hot iron, the iron will burn with an intense flame, and flow like water, the liquid drops gathering at the end and falling off. This experiment is made easily. For the source of oxygen, you need only heat some potassium chlorate in a test tube fitted with a glass elbow which in turn carries a medicine dropper, through the small hole of which the oxygen gas issues. Potassium chlorate is used in solution for relieving irritations of the throat, and tablets of this material can be used to make the oxygen gas. Heat the test tube until the crystals or tablets melt, and the oxygen will come off quite readily.

To show the action of some wonderful substances that are called *catalyzers*, insert into the under side of the cork of the test tube a brass headed tack, in the inner cup of which is placed some powdered manganese dioxide (pyrolusite mineral). When the potassium chlorate in the test tube is melted and oxygen gas is coming off, as ascertained by holding a glowing match at the end of the medicine dropper, shake the test tube so that the

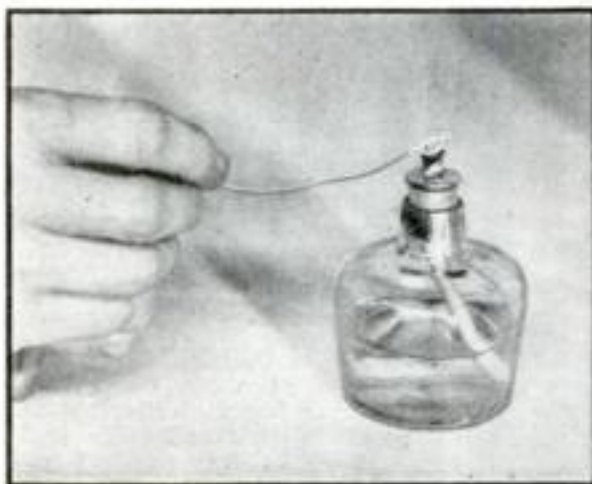


Fluffy wads of cotton, dipped in aluminum bronze, will burn with a bright flash when ignited

manganese dioxide powder falls from the inverted tack into the molten chlorate.

Immediately the flow of oxygen is increased, the manganese dioxide having catalyzed or hastened its formation. If a piece of iron wire is heated red-hot and placed in the stream of oxygen issuing from the medicine dropper, it will burn and melt, the liquid drops of iron falling off like water from an icicle.

Alcohol will burn, or completely oxidize, to form water vapor and carbon dioxide gas. When only partly burned or partly oxidized, formaldehyde gas is formed. This experiment is usually carried out with fine



If a piece of red hot manganin wire is placed in vapors of alcohol it will continue to glow

platinum wire heated to redness and held in the vapors of alcohol.

The writer has found that a piece of fine (No. 30) manganin electrical resistance wire will produce the same effect. If the wire is heated and placed over the wick while red-hot, it will continue to glow, heated by partial oxidation of the alcohol, and formaldehyde gas will be formed.

Hydrogen gas is unlike oxygen, for it reduces or abstracts the oxygen from many substances which contain it. Copper wires, if heated, will combine with the oxygen of the air to form black copper oxide. If these particles of black copper oxide are heated in the bowl of a clay pipe attached to a bottle or flask in which hydrogen gas is being generated, the hydrogen gas will remove the oxygen from the black oxide, bringing back the bright metallic copper. Hydrogen gas can be made by allowing muriatic acid to act upon scraps of zinc.

This little clay pipe reduction apparatus can be used for many other experiments. Iron rust (iron oxide) can be changed to iron metal, by allowing hydrogen gas to pass through the pipe while the rust is heated in the bowl. Iron tacks, heated in the bowl, will be changed to iron oxide if steam is passed through the pipe, hydrogen gas being formed.

A simple experiment to show the rusting of iron and that in rusting, oxygen is taken from the air and united with the metal, is performed by inserting a wad of steel wool in an inverted test tube, the mouth of which is immersed in water. The iron will rust, uniting with the oxygen of the air in the tube, thus producing a lessening of the pressure within the tube, and a rising of the water which is forced in by the atmospheric pressure outside.

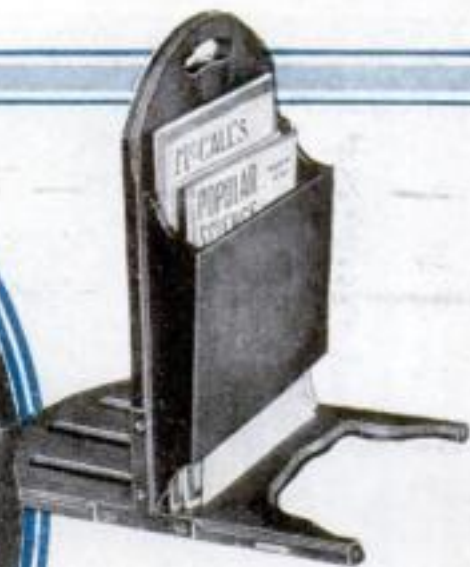
Magnesium and zinc metals will burn in the air with the production of a vivid light. Zinc metal, such as scraps taken from a dry cell, if heated in the bowl of a bubble pipe will burn and produce white powdery zinc oxide in the bowl.

Eighteen New Inventions

PASTE TUBES STAND UP. The tray shown below is a new accessory for the bathroom. It is a six-inch tray into which the clip at the bottom of tubes fit so they are held in upright position.



RACK AND FOOT REST. The comfortable foot rest shown at left is an attractive magazine rack, above, when it is standing upright. Merely tilting it over on its projecting base converts it from a rack to a sturdy foot rest.



TILE THAT CLIPS ON. When a line of special grippers has been set into the bathroom wall, this tile snaps into place and stays there.

NEW CAN OPENER. Sardine cans are easily opened with the combination key and lever, below, that grips the lash. It also is fitted with a fork to lift out contents.



ROLLING CLOTHES BRUSH. Above are two views of a new clothes brush that takes the shine out of fabric and renews the appearance of the cloth by raising it. Points of metal wire, on rollers, do the work without injury to the fabric.

A FOLDING BENCH. At right and below are two views of a collapsible bench that is also adjustable. It was designed primarily as child's dressing bench and can be set up and taken down quickly and also made higher or lower to fit the child using it. When not in use, it folds compactly and stores easily.



WINDOW CAN'T RATTLE. Mounted on top of the lower sash, this device with a rubber-tipped plunger exerts pressure against the upper sash when the trigger is pulled with a flip of the finger and stops rattle.



TONGS FOR CLINKERS. A lever in the handle of these tongs controls the movable finger of the foot which seizes the clinker and holds it firmly so it can be drawn out of furnace.

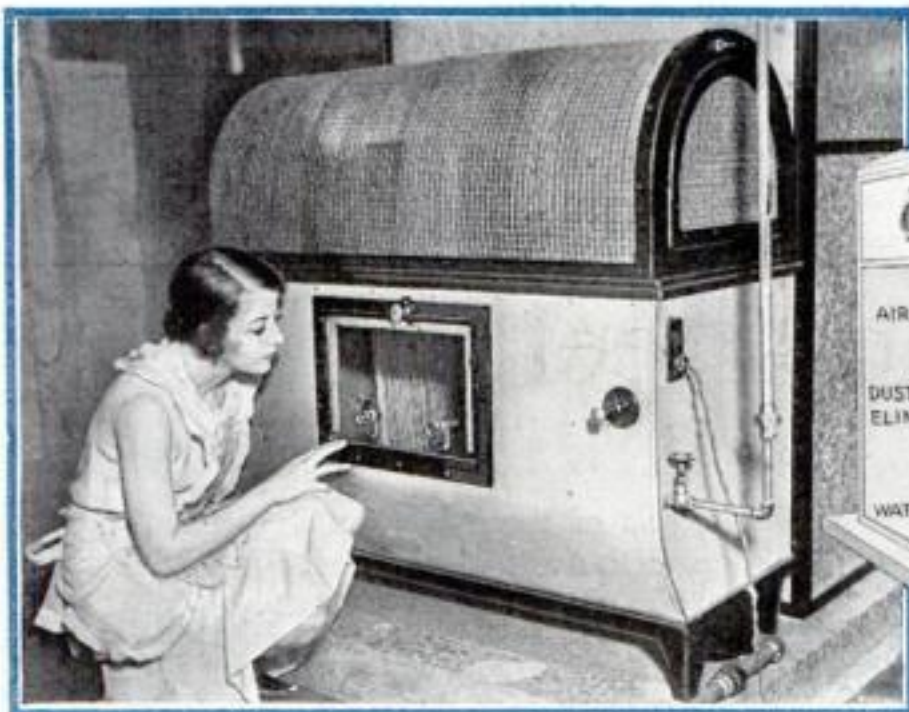
ORANGE PEELER. Jaws, with sharpened edge, grasp the fruit and cut the peel, as the orange is rotated, without digging into the fruit. Thus loosened, peel is removed with fingers.



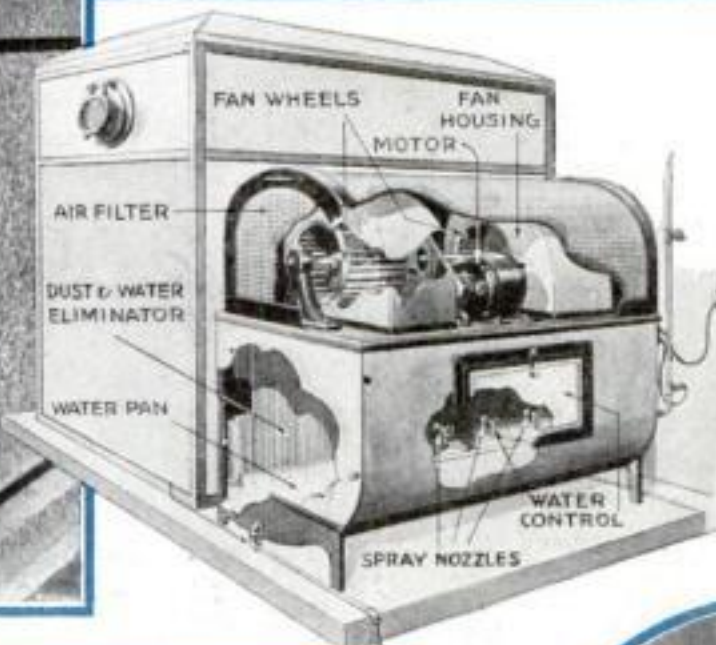
POTATO MASHER. In this potato masher, a pivoted handle extension is swung back and forth across the grille, cleaning it automatically and letting the mashed potato go through.



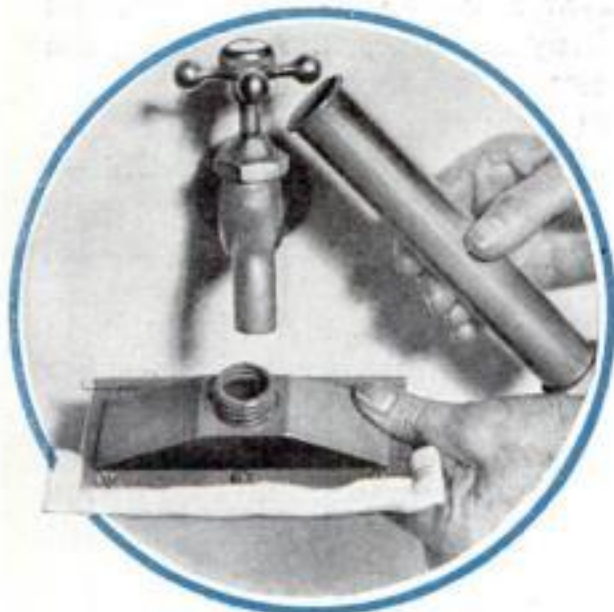
that Aid the Housewife .



WINDOW CLEANER. Below is shown a window cleaning tool designed to facilitate the washing of glass in either home or auto. The reservoir is filled and pressure against the glass forces water through pad, cleaning the glass



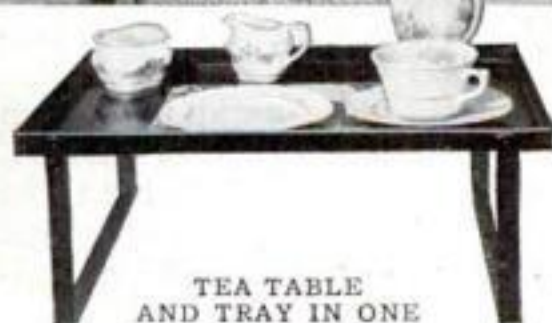
MAKE YOUR OWN WEATHER. A weather making unit for the home, the operation of which is shown in accompanying drawing, can be attached to the heating plant, as illustrated in picture at the left. It is operated with a push button and washes and filters the air and makes it unnecessary to ventilate with windows. Air from the living rooms is returned to the apparatus for reconditioning through grilles in the floor or baseboard



NEW GRATER HAS GUARD. In using this vegetable grater, the hands are protected from injury by a guard that fits above the grater. It is provided with various disks so that any vegetable may be sliced, shredded or minced



NONSLIP CARVING DISH. Small metal hooks, set in the grille of this carving dish, grasp the meat and hold it so it can't slip and insures even carving to the last slice



TEA TABLE AND TRAY IN ONE

Combined in a single utensil for the home, this inexpensive tea table and tray serves many purposes. It can be used by an invalid as a bed table, by children as a play table, or taken on the lap as a writing desk. It is made of sheet steel, has no loose parts, and is painted in oil



ASH RECEIVER. Set in a vault beneath the furnace, this receiver gets ashes directly from the pit, thus keeping the furnace room clear of dust. The can rotates, coming out in front of the furnace so that it can be removed for emptying. Installation, it is said, is possible with any furnace



ELECTRIC MOTH BALL. Attached to a light socket, a bulb inside this ball generates enough heat to vaporize the chemical with which it is filled. This vapor exterminates moths and larvae



STRAINER FOR SINK. At left, a removable strainer that fits over sink strainer and acts as a stopper to hold water in sink and prevent debris from clogging the pipes

Trust Science and Feel Secure

SCIENTISTS long have been accused of spoiling people's illusions. Artists, for example, throw up their hands in horror at the idea of anyone analyzing a sunset in terms of molecules, gaseous diffraction, and wave lengths of light. Yet when the illusions fade and emotions are sour, people instinctively turn to the hard, cold facts of science to find out what's wrong and what should be done about it.

Back in 1929, when everybody was riding on the crest of a huge illusion of super-prosperity, people scoffed at the scientific laws of economics. Stuffy principles of supply and demand, they said, belonged to an outmoded era and were just so much stale apple sauce. When the balloon finally burst with a resounding pop, just as all balloons must when filled with too much hot air, we all came down to earth with a disturbing abruptness.

In place of unwarranted optimism, we are now sunk in equally unwarranted pessimism, since the pendulum of human feelings always swings much too far. During the height of the boom, the few who advocated caution might just as well have saved their breath for all the attention anyone paid to them. Now our gloom is so deep that we look with suspicion on anyone who predicts the quick return of prosperity or even suggests its possibility at some future date. To hear people talk, you'd think that business had gone completely to pot and was never going to be any good again.

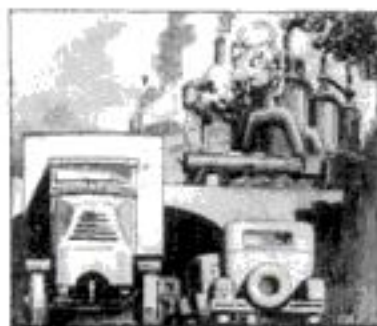
Business Just Can't Stay Bad

That attitude is ridiculous, first because business hasn't gone to pot and second because it would be a scientific impossibility for it to stay poor indefinitely.

Is it possible for any sane person to say that business is a heap of smoldering ruins when people paid nearly a billion and a half dollars for new passenger automobiles and trucks during 1931?

Can anyone say that business is shot to pieces when, in a country where twenty-three million motor cars are in operation, one for every four or five citizens, we add in one year nearly two and a half million gasoline vehicles and spend nearly two and a half billion dollars for roads on which to operate them?

Why get haired up over the approaching dissolution of a country that, in the worst year of the depression, passed nearly three hundred and fifty million



barrels of gasoline through the carburetors of autos and pays over a billion dollars in taxes for the pleasure of doing it?

If we are all broke and expect soon to be still worse off, who has been wearing out the fifty-one million auto tires that rolled their lives away on our roads last year?

How about the more than four million citizens who gain their livelihood in the automobile business? If everybody is broke, who is paying the enormous sum represented by their salaries?

An analysis of 1931 sales of other commodities that have nothing to do with the three prime necessities—food, shelter, and clothing—shows staggering sums spent by the American public for cosmetics, cigarettes, movies, and so on.

Although an unusually large number of people in this country are close to actual want, it is quite obvious from a scientific analysis of the figures that the larger part of the population has not, as yet, had to do without even the luxuries. Certainly no nation can be on the brink of ruin so long as that situation remains.

Little Difference between Boom and Crash

The trouble is, of course, as the scientific facts amply prove, the difference between a boom and a depression is much less than most people realize. If there are nine auto tires for sale and ten people want them, there's a boom in tires. If ten tires are on hand and only nine people want them, the tire business goes flat.

During a period of boom times manufacturers become inflated with an overdose of optimism and this results in equally inflated estimates of sales possibilities.

The minute any industry develops a production capacity greatly in excess of the possible demand, everyone connected with the industry is going to be in for lean pickings. When too many industries get into that condition, we have what is called a business depression.

What always happens in such cases is that the weaker manufacturing units go to the wall and in due course of time this balances the supply with the demand and things again become normal.

Is there any valid reason why, in the case of the present depression, the law of supply and demand will not work out exactly as it always has?

Old Battery Set *can use* A.C.

Full Directions and Diagram Show You Exactly How Rewiring Is Done to Give You a Radio Operated in Strictly Modern Way

By ALFRED P. LANE

MANY readers have requested diagrams showing how to rewire some particular make of old battery set for operation on alternating current. There are so many different models of battery sets still in use and so many different ways to rewire them that diagrams covering all possible variations would fill a big book.

We believe that the best method, and the one that will produce the most satisfactory results, is to study the general principles as they apply to any kind of alternating current rewiring job.

To begin with, as far as the radio signal coming in over your antenna is concerned, the action that goes on in each stage of a radio receiver is precisely the same whether the circuit is operated from batteries or from alternating current. In each case the flow of electrons within the vacuum tube causes the action. It makes no difference to the radio signal whether these electrons come from a filament directly heated by the flow of battery current or from an equivalent cathode indirectly heated by alternating current at low voltage.

The grid and plate connections of equivalent battery operated and alternating current operated tubes invariably are the same. The difference is in the current supply system.

If the socket connections are easy to get at, a conversion job is simple if you bear these rules in mind.

Suppose you wish to substitute a type 227 alternating current tube for a 201A, its radio equivalent. This job is shown in successive stages in the illustrations on this page.

THE upper left figure shows the typical 201A socket hook-up before you start rewiring. Upper right shows the first step, removing the G and P wires and carefully tagging them, and removing the filament wires and twisting the ends together. In case the socket terminals are not marked, you can identify them by referring to the locking pin on the side of the tube base. Looking down at the socket, the G binding post is the one that makes contact with the prong to the left of the locking pin. The P terminal makes contact with the prong to the right of the locking pin. The G and P prongs are the two with smaller diameters. The filament terminals engage with the larger prongs on the far side from the locking pin.

Center left shows the next step, the removal of the old

socket and the substitution of the new Y-type, five-hole socket. The G terminal of this socket always is the one that makes contact with the prong that stands away from the others. You will have no difficulty in this respect, however, as the terminals of the new socket will be marked.

Center right illustrates the fourth step, reconnecting the G and P leads to the new socket.

The fifth step, lower left, shows the connection of the K or cathode terminal of the socket to the old filament wiring by way of a fixed resistance bridged by a fixed condenser. This is the proper arrangement for any tube in a radio-frequency or first audio-frequency amplifier stage, and the value of the resistance should be approximately 1,500 ohms with a .1-mfd. condenser by-passing it if the stage is R. F. or a 1-mfd. if first audio. If the tube happens to be the detector, then the K terminal should be connected

directly to the old filament wiring without any resistance or condenser.

The sixth step, lower right, is to connect a twisted pair of wires to the H terminals of the socket and run these wires to a source of alternating current at $2\frac{1}{2}$ volts pressure, such as the secondary terminals of one of the special heater, or so-called filament transformers, made for this purpose.

NOW if you supply B current from a factory or home built B eliminator with the minus B connected to the old filament wiring and the plus to the proper plus B binding post of the set, the circuit, as far as this particular tube is concerned, is complete.

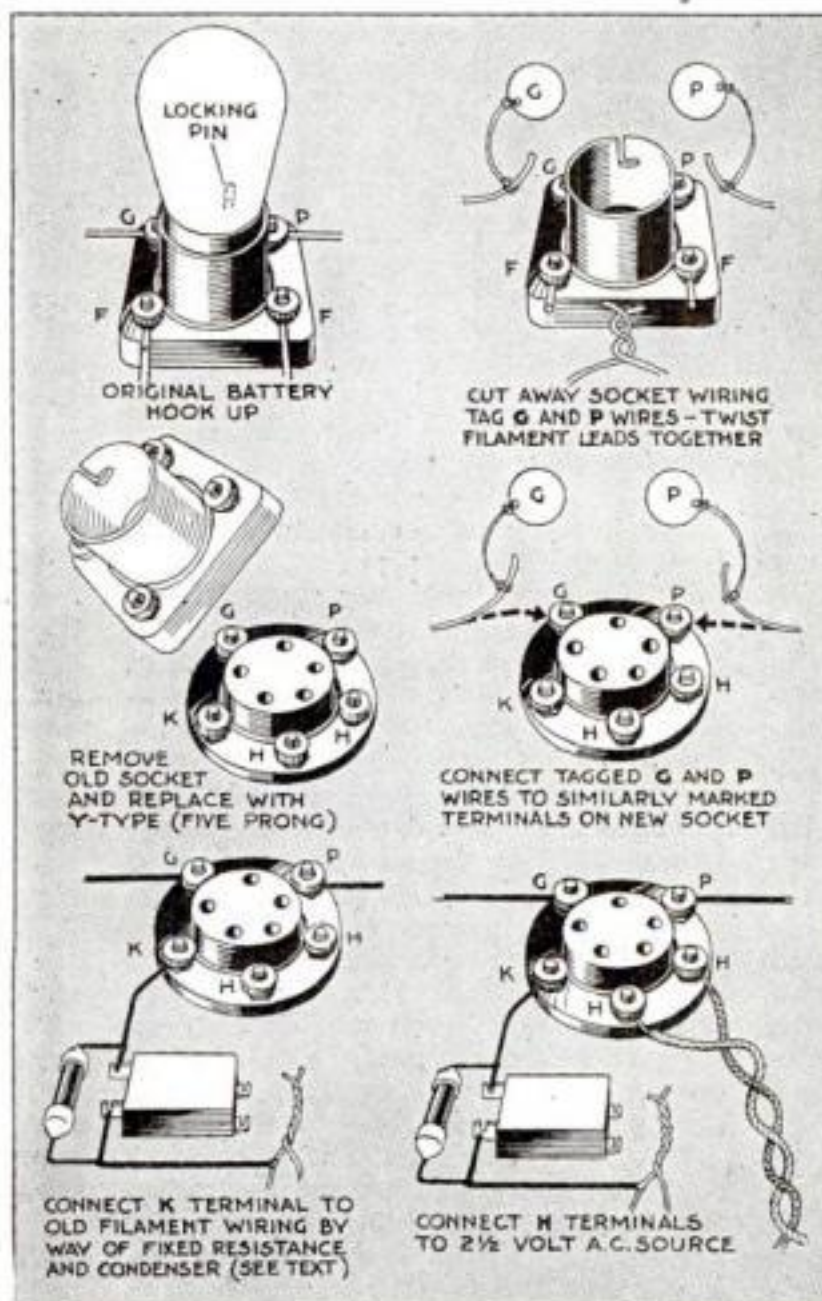
Handling the power tube in the last audio stage of the set is even simpler, as you do not have to change the socket. To convert the power tube to alternating current operation, remove the original filament wiring and substitute new twisted leads running to a separate heater winding on the same transformer or to a separate heater transformer. The A. C. voltage should be 5 if you want to continue the use of the 171A tube or $2\frac{1}{2}$ if you wish to substitute a type 245.

Then a biasing resistance is connected in with one end to the center tap of the power tube heater winding and the other to the old filament wiring, which in the new circuit becomes the common minus B connection for all tubes. This resistance should have a value of 2,000 ohms in the case of the 171A tube or 750 ohms for the 245 tube. It should be bridged by a 1-mfd. condenser.

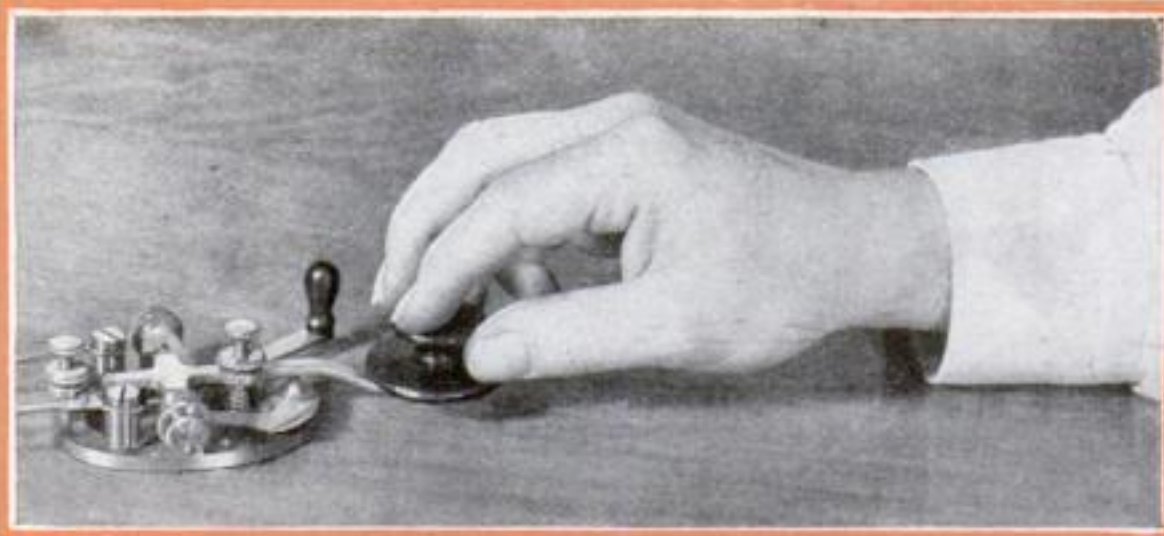
Converting a set already using the 171A tube to A. C. operation would be complete at this point, but if you wish to substitute a 245 tube, you will have to put in a new output transformer because of the heavier plate current.

POPULAR SCIENCE MONTHLY cannot supply any wiring diagrams showing conversion jobs, as there are too many variations, but if you will work out for yourself a diagram as you think it applies to your own set, we will be glad to check it for you and see that you have it right before you start work.

Working out a diagram of this kind will prove interesting and instructive. The first step is to make a large diagram of the wiring in your set as it now stands. Then compare it, stage for stage, with the instructions given on this page and you will be able to make the necessary changes.

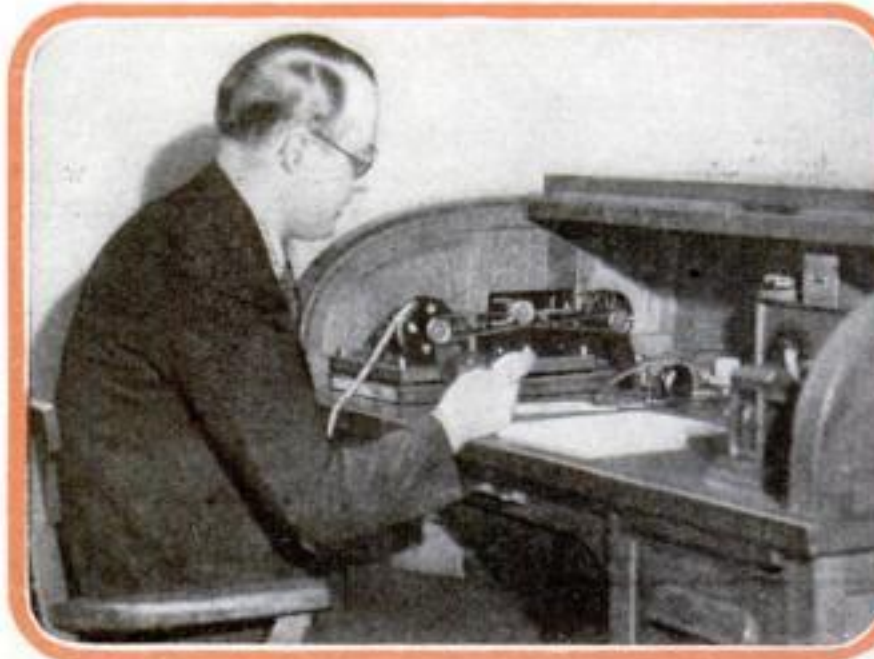


This diagram shows the six stages in the process of rewiring an old battery set so that it can use alternating current. Upper left is the first step and upper right the second. The operation is repeated on each tube of your set



...Thousands of **RADIO AMATEURS** find it easy to

Learn CODE



A Government examiner giving test with a stop watch held on automatic sender. Upper right, position of hand on key

DIT-dit-dit-dah! Dit-dit-dit-dah! The staccato of Continental Morse Code buzzed through a dozen headphones into as many ears. All up and down the line pencils came to nervous and somewhat trembling attention, for the code test in the U. S. Government's examination for amateur radio operator's license was about to begin. For five minutes not a sound was heard in the room except the scratching of pencil on paper.

This scene has been repeated many times in the past and will be reenacted many times in the future. There are now more than 20,000 active licensed radio amateur operators in the United States and several times that number who have passed the test but who are, for one reason or another, not engaged in amateur radio operation at present.

While the vast majority of licensed amateur radio operators are young persons of high school and college age, there are large numbers of grown-ups in the game. Doctors, lawyers, bankers, and members of virtually every other profession and trade are represented. Quite a

large proportion of these mature amateur radio license holders are men who originally dabbled with radio broadcast reception and have now found the supreme thrill in radio—long distance two-way communication.

The Radio Division of the United States Department of Commerce gives the examinations for, and issues licenses to, all grades of radio operators. Paragraphs 9 and 10 of the regulations issued by the Radio Division relate to amateur radio operators. They read as follows:

"9. Amateur Class. Applicants for this class of license must pass a code test in transmission and reception at a speed of at least 10 words per minute, in Continental Morse Code (5 characters to the word). An applicant must pass an examination which will develop knowledge of the adjustment and operation of the apparatus which he desires to use and of the international regulations and acts of Congress in so far as they relate to interference with other radio communications and impose duties on all classes of operators. A percentage of 75 will constitute a passing mark. This license is valid for the operation of licensed amateur radio stations only.

"10. Temporary Amateur License. Amateurs who can not present themselves for examination may be issued temporary licenses valid for the operation of a particular station until such time as they can be examined for a regular license but not to exceed a period of one year. The applicant must submit a sworn statement attesting to his ability to transmit and re-

ceive at a speed of not less than 10 words per minute in Continental Morse Code, and must complete a questionnaire pertaining to the operation of his transmitter."

It is evident from these regulations that you have to know something about the technical side of radio. A question frequently asked in these examinations for an amateur operating license may read something like this:

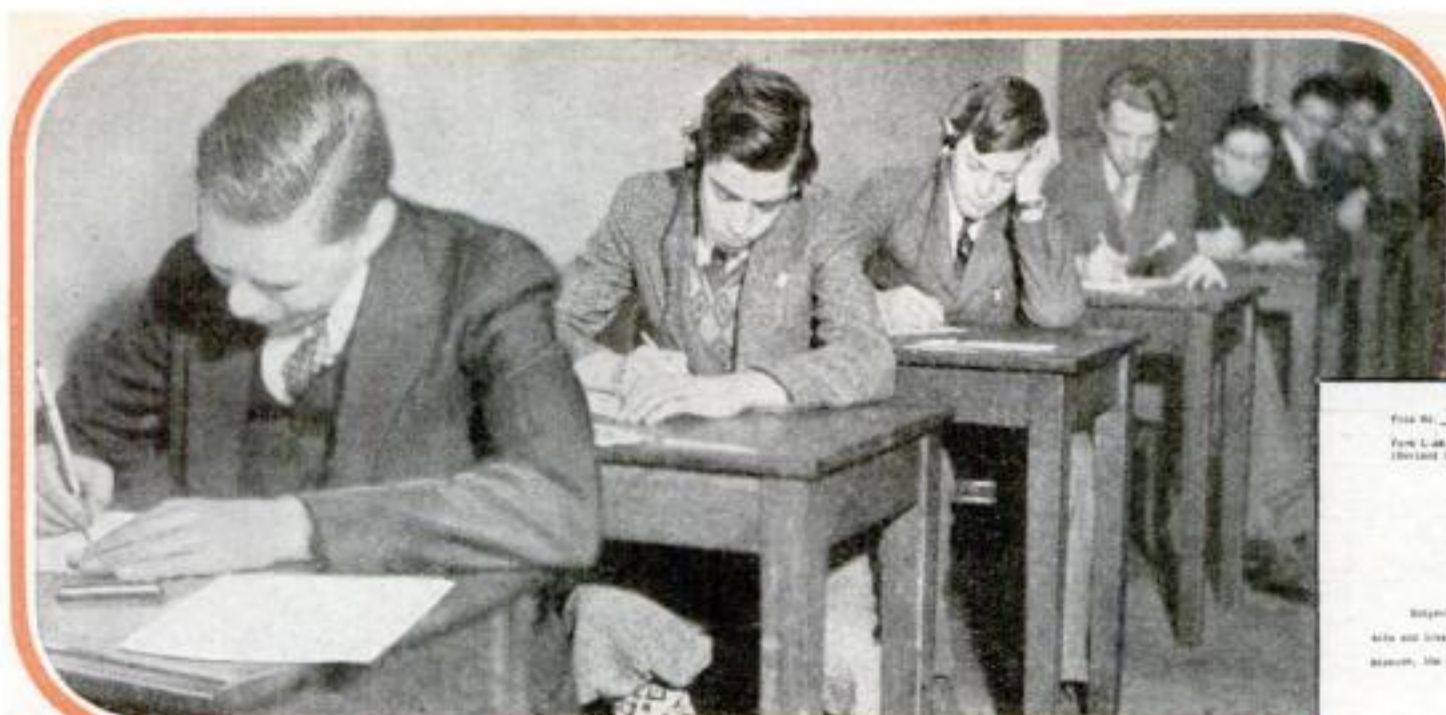
"Draw a theoretical diagram of a simple radio transmitting circuit complete with power supply and explain in detail the function of each part in the circuit."

Obviously, the radio experimenter who doesn't know a radio symbol when he meets one face to face, and who builds his radio sets by rule of thumb from picture diagrams without having the faintest idea of the electrical functions of the parts, hasn't the ghost of a show to get an amateur radio operator's license.

ON THE other hand, it is not difficult to acquire the limited amount of electrical knowledge required. You must first master the elementary principles of electricity as given in the simpler textbooks on the subject. Then you must apply the principles of magnetism and electromagnetic action plus an understanding of the radio vacuum tube to mastering simple radio transmitting and receiving circuits.

This knowledge is obtainable from any one of a number of different textbooks on elementary radio. You don't have to know all the ins and outs of complicated radio broadcast transmitting circuits, nor do you require a detailed knowledge of elaborate receiving circuits such as the superheterodyne. You must know, however, exactly how a radio wave is produced in the simple vacuum tube oscillating circuit and just how this wave is detected and made audible by a simple vacuum tube receiving circuit.

The reference to international regulations mentioned in the paragraphs quoted above refer in particular to a knowledge of



Left, radio amateurs taking an examination in an effort to secure an operator's license. They must be able to receive ten words a minute. Below, copy of Government amateur station license

Form No. 1
 Form 1-46
 (Revised 4-29-32)

License No. 3-10-32

UNITED STATES OF AMERICA
 FEDERAL RADIO COMMISSION

AMATEUR RADIO STATION LICENSE

Subject to the provisions of the Radio Act of 1927, as amended, and subsequent Acts and Decisions, and all regulations heretofore or hereafter made by this Commission, the Licensee:

Heretofore, *James H. Carr*
 (Age 32) (City, State, and Country)
 (Date of Birth)
 (Date of Issue)
 (Date of Expiration)

is hereby authorized to use and operate the radio transmitting apparatus at the location and under the call letters stated herein, for the term beginning December 31, 1932, and ending December 31, 1937.

The Licensee shall use and operate such apparatus only in accordance with the provisions of the Radio Act of 1927, as amended.

This license shall not entitle the Licensee any right to operate the station nor any right to the use of the frequencies authorized in the license beyond the term thereof, nor in any other manner than authorized herein. Neither the license nor the right granted hereunder shall be assigned or otherwise transferred in violation of the Radio Act of 1927, as amended. This license is subject to the right of use or control by the Government of the United States conferred by Section 5 of the Radio Act of 1927.

Given at Washington, D.C., December 28, 1932

By Direction of the Federal Radio Commission
James H. Carr
 Licensee

and Get License

By
JOHN CARR

the wave lengths or frequencies on which amateur operation is permitted and which will be dealt with more specifically in subsequent articles treating of the construction of radio transmitters and receivers suitable for use on these frequencies.

There is a long list of so-called "Q" calls. These are three-letter combinations which stand for whole sentences most used in radio communication.

The amateur must recognize "SOS," the international distress signal; QRT, which means "stop transmitting at once" when sent out by any Government station; and a few others.

All amateur activity centers around a knowledge of the Continental Morse Code. Even the amateurs who are interested only in amateur radio phone work must know the code, since they have to pass exactly the same tests as do those who are interested only in code.

In my last article on this subject (P.S. M., Jan. '32, p. 69) the construction of a small oscillator to produce code practice signals was described. This article also gave the radio code with the letters arranged so that memorizing is easy. Please note that the figure three in this table is incorrect. It should be . . . — — and not . . . — — — as shown.

IN MEMORIZING the code, try to think of the letters as different sounds rather than as so many dots or dashes. Think of letter C, for example, as "dah-dit-dah-dit" and not as dash followed by dot, followed by dash followed by dot.

Obviously, it is a great advantage for two beginners to work together. One can transmit for the other, and so on.

Learning to transmit the Continental code with a key seems to the beginner much easier than learning to receive the code and write on paper its letter equivalent. This apparent ease in sending leads many beginners into a fatal error. Finding it relatively easy to make dots and dashes with a key and the brain naturally supplying code for letters quicker than it can



Operators receive the Government license that entitles them to operate an amateur radio station. Background shows a reproduction of coveted license

supply letters for code, he starts in to send much faster than he can receive.

Make it a steadfast rule never to attempt to send at a speed faster than you can receive. If you can only copy at five words a minute, then limit your sending speed to that rate and concentrate your attention on forming each letter with machinelike precision.

The position of the key and the way you use it are of great importance. The key should be so far in from the edge of your radio bench or table that you will have a firm rest for your elbow. The position of the hand on the key is shown in the pic-

ture at the top of the page opposite.

The correct motion should be a steady flexing of the wrist. By combining a wrist motion with an arm wiggle it is possible to send dots at surprising speed, but the combination motion is very tiring and leads to erratic and unreadable sending.

While the Government license test only calls for a speed of ten words a minute, I suggest that you do not take the test till you can be sure of at least twelve words a minute (sixty characters) in your tests at home. Remember that if you fail to pass the test, you will not be permitted to take it again for three months.

Your Next Car...New or Used?



Gus Says Some Second-Hand Autos Are Good, But When You Select One, Watch Your Step

By MARTIN BUNN



TAKE a real good look at her, Gus. This is the last time you'll set eyes on the old machine," Sam Fosskett said regretfully.

Gus Wilson, half owner of the Model Garage and expert auto mechanic, smiled. "I was kind of wondering how much longer you were going to keep it," he observed, as his keen glance wandered over the traffic-scarred veteran of thousands of motoring miles. The paint job, once Fosskett's pride, had faded to a dingy gray where it was not completely missing. The top was streaked and patched. The holes rusted through the fenders hinted at approaching dissolution.

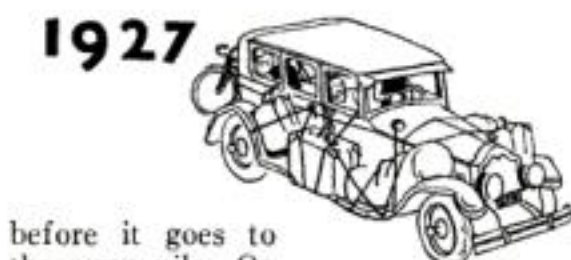
"Yeah," Fosskett grumbled, "I've got to get a new bus. The missis put her foot down. She swears she won't ride another mile in this one. It's a shame, too; the motor still runs pretty well."

"You mean it still runs," Gus grinned. "You're so used to it you don't realize how bad it is."

"Maybe so," Fosskett agreed. "But what I want to know is, should I buy a new car or a good secondhand one? I've taken demonstrations in most of the new ones and some of them are mighty sweet-running jobs. On the other hand, with things the way they are, secondhand prices are down and I've seen some almost new cars that look like real bargains. What do you think, Gus?"

"Even King Solomon couldn't answer that one," laughed Gus. "Ask a couple of dozen experts that question and you'll get a couple of dozen different answers—each one of them right, but not necessarily for you. It all depends on how you look at it."

"Some engineering institute checked up on a lot of cars and found that the average life of a car is fifty thousand miles



before it goes to the scrap pile. On that basis, this car," Gus continued, "is due to be scrapped because you've exceeded that mileage already."

"They also worked out fancy curves to prove what everybody knows, which is that the secondhand value of a car is determined by how long it is since it left the factory, whereas the life of a car, speaking mechanically, depends not on years but on mileage."

"That's what style does, I suppose," Fosskett interrupted. "The same thing makes clothing dealers put bargain prices on clothes rather than hold them over for another year, when they'd have to sell them cheap anyhow because by then they'd be out of style."

"Exactly," Gus replied. "And that's why advice is no good. It all depends on what you expect to get when you buy the car. Of course, if it's just a matter of buying so much transportation for so many dollars, then there's no doubt but what you get the most for your money on the average by buying a secondhand car about one year old."

"Why do you say 'on the average'?" Fosskett wanted to know. "If they've actually gone to the trouble of figuring an average, then it must be so."

"Listen," said Gus, "you're not buying an average, you're buying an automobile; and the two aren't the same. The average height of a man is five feet six

1929



or seven inches, but I'll bet you couldn't go down this street and find a single man on it that is exactly the average height. The point is, while an average car would be a good buy, that doesn't prove the one you buy is going to turn out right. You may get a much better bargain than you hoped for, or you may pick some lemon that's had the life driven out of it by an inexperienced owner."

"Humph!" Fosskett snorted. "New cars sometimes turn out to be lemons, too. Remember Lambert's car, the one he bought two years ago? Nothing but trouble from the time he got it till he got rid of it."

"That's right," Gus nodded. "There never was a factory

turning out any product that didn't make a bad one now and then. But the percentage of Jonah cars is very small nowadays. Ninety-nine times out of a hundred you can bank on a new car being right if you treat it right."

"You said a (Continued on page 103)



1932





MODEL MAKING : HOME WORKSHOP CHEMISTRY : THE SHIPSHAPE HOME

The Latest Idea in Home Boat Building

Our New 3 in 1 HULL

...Can Be Made in Three Sizes
and Used with Oars or with an
Outboard or Inboard Motor



Mr. Jackson, who is a naval architect, found this 14½-ft. hull behaved well with motors of various types and sizes

EASE of construction, low cost, safety, speed, seaworthiness, and durability are the outstanding features of the new POPULAR SCIENCE MONTHLY three-in-one boat *Vagabond*.

All the necessary working drawings for making the hull in any one of three sizes can be obtained for 25 cents (see page 110). If you wish to make the smallest size—13 ft. long, 4 ft. 6 in. beam—send for Blueprint No. 147. The second size—14½ ft. long, 4 ft. 8 in. beam—is shown on Blueprint No. 148, and the largest size—16 ft. long, 4 ft. 8 in. beam—on Blueprint No. 149.

You can build her first as a rowboat, if you wish, and then add an outboard motor later on; or with a little additional work you can install a small inboard motor aft and use it in connection with a stern drive, thus converting the craft into a smart little inboard. A supplementary blueprint, showing how to make this conversion, can be obtained for 25 cents (Blueprint No. 150).

The boat illustrated is 14½ ft. long. The cost of the materials—lumber, hardware, paint—was \$50 in the small town in Indiana where the writer lives. Oak was used for the frames and mahogany for the planking. The materials for the 13-ft. hull would be about \$5 less, and for the 16-ft. hull, \$8 more. The 14½-ft. hull weighs 350 lb.; the 13-ft. hull would be about 275 lb., and the 16-ft. hull, 385 lb.

By

WILLIAM JACKSON

The hulls are suitable for A, B, C, D, E, and F outboard motors. The speed will range from about 15 to 35 miles per hour, or even more, depending upon the motor.

Building the form is the first step. This may be constructed of any straight 2 by 10 in. rough lumber. Set the form up on

wooden legs, like a giant sawhorse, or fasten it on two ordinary sawhorses.

Next prepare full size paper patterns of the various frames and the stem, following the dimensions on whichever blueprint you are working from. The plans show only half of each frame; it will be necessary, however, to draw both sides on the patterns. (Mr. Jackson will be glad to help readers by cutting out a complete set of patterns of the frames, stem, and deck beams for any one of the boats. If

*For the first time we offer . . .***A Complete Boat Building Blueprint**

NEVER before in all its boat building articles has POPULAR SCIENCE MONTHLY been able to offer as much in value and in variety as in this new motorboat.

for 25 cents

First, you have your choice of three favorite sizes—13, 14½, and 16 ft. in length.

Second, each boat is in itself a three-in-one combination. It can be used with oars, with an outboard motor, or with a small inboard motor installed at the stern and used with one of the new stern drives which promise to be so popular.

Third, you can obtain a blueprint with complete drawings of any one of the three boats for twenty-five cents. Each blueprint contains assembly drawings, fully dimensioned layouts of all the frames and motor board, and details of the frame construction, keel, and stem. A fourth blueprint is available, too, for those who desire details for the installation of a stern drive. In sending for blueprints, please use the coupon on page 110 and order by number as follows: 13-ft. boat, No. 147; 14½-ft. boat, No. 148; 16-ft. boat, No. 149; stern drive details, No. 150. Full size patterns of each boat are also available at \$1.50 a set.

you wish a set, order it from the Blueprint Service Department and inclose \$1.50 to cover the cost of preparation.—THE EDITOR.)

When the patterns are ready, lay the $\frac{5}{8}$ by 3 in. frame material on them and saw the pieces to shape. The bottom pieces are joined together with a $\frac{5}{8}$ by 3 by 12 in. oak block or "floor." Coat the floor piece with waterproof glue and attach to the frame with eight $1\frac{1}{4}$ -in. No. 8 flathead screws. Bolt the side member to the bottom member with two $\frac{1}{4}$ by $1\frac{1}{2}$ in. carriage bolts.

The transom frame is secured at the chines with a $\frac{3}{8}$ by 7 in. block, fastened with six $1\frac{1}{4}$ -in. No. 8 flathead screws. The transom frame is not planked until the entire framework is completed. Attach cross strips to hold the frames in shape.

The pieces for the stem are now sawed out. The stem is fastened together with four $5/16$ by 5 in. carriage bolts. Hack saw the sides of the bolthead off, so the head can be countersunk in the stem. The sectional drawings of the stem on each blueprint show the various bevels. Mark and plane the bevels; then chisel out the rabbet $\frac{3}{8}$ in. deep so the planking will fit flush.

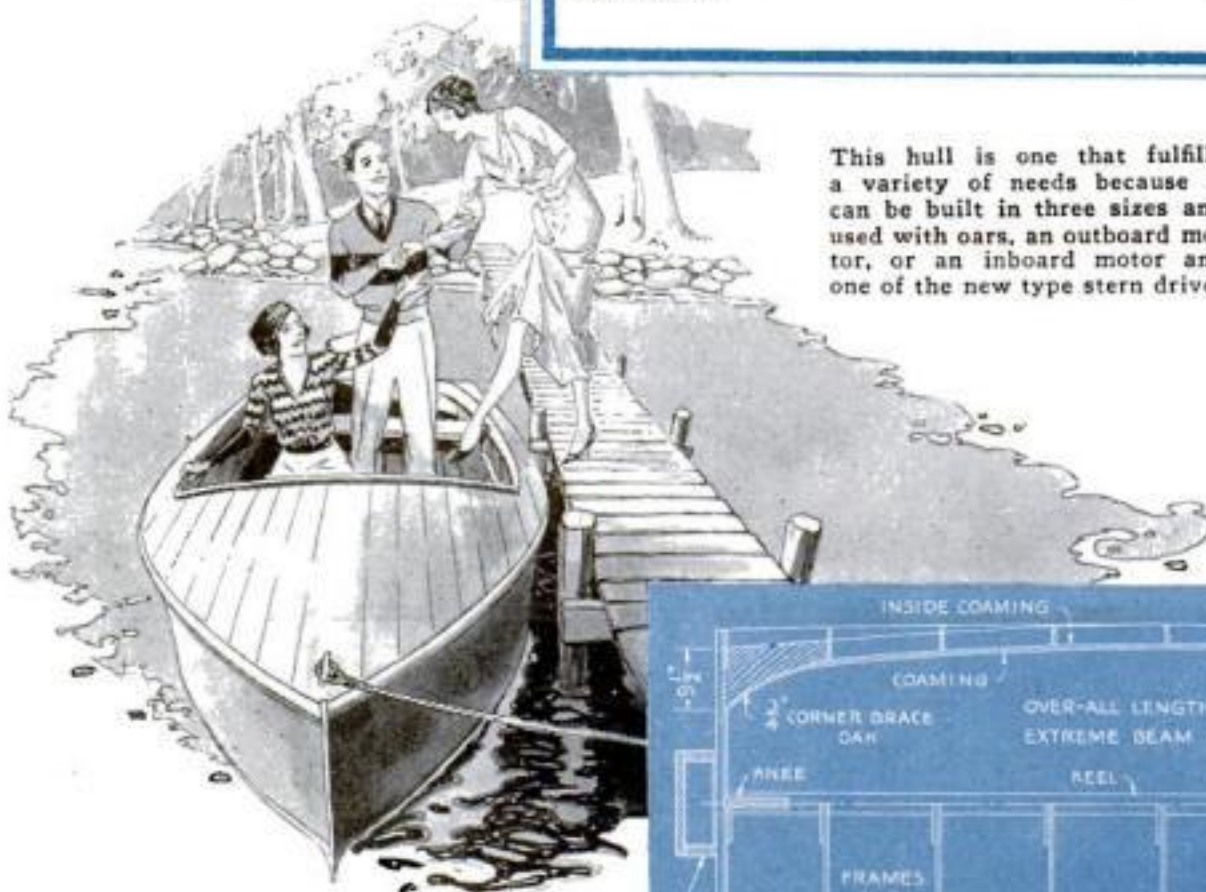
With the frames finished, saw out the chine, keel, and inwale notches. Clamp the frames temporarily to the keel, and mark on

List of Materials for Building Hulls

Part	Material	Size of Stock	For 13-ft. Hull	For 14½-ft. Hull	For 16-ft. Hull
Planking and decking	Mahogany, cypress, white pine, red or white cedar	$\frac{3}{8}$ by 6 in. $\frac{3}{8}$ by 8 in.	2 pc. 14 ft. long 11 pc. 14 ft. long	13 pc. 16 ft. long 2 pc. 14 ft. long	13 pc. 17 ft. long 2 pc. 14 ft. long
Outside coaming	Same as above	$\frac{3}{8}$ by 3 in.	2 pc. 10 ft. long	2 pc. 10 ft. long	2 pc. 12 ft. long
Sheer plate	Same as above	$\frac{3}{8}$ by 12 in.	2 pc. 10 ft. long	2 pc. 12 ft. long	2 pc. 14 ft. long
Inside coaming	Fir or spruce	$\frac{3}{8}$ by $1\frac{1}{2}$ in.	2 pc. 8 ft. long	2 pc. 9 ft. long	2 pc. 10 ft. long
Cockpit end piece	Mahogany or cedar	$\frac{3}{8}$ by 8 in.	1 pc. 4 ft. long	1 pc. 4 ft. long	1 pc. 4 ft. long
Frames	Oak, fir, or spruce	$\frac{5}{8}$ by 3 in. $\frac{5}{8}$ by 6 in.	4 pc. 16 ft. long 1 pc. 2 ft. long	5 pc. 16 ft. long 1 pc. 2 ft. long	5 pc. 16 ft. long 1 pc. 2 ft. long
Deck beams	Oak, fir, spruce, or yellow pine	$\frac{5}{8}$ by 8 in. $\frac{5}{8}$ by 12 in.	1 pc. 10 ft. long	1 pc. 12 ft. long	1 pc. 12 ft. long
Seats	Oak, fir, spruce, mahogany, cypress	$\frac{3}{4}$ by 12 in.	1 pc. 10 ft. long	1 pc. 10 ft. long	1 pc. 10 ft. long
Floor boards	Same as above or yellow pine	$\frac{1}{2}$ by 4 in.	10 pc. 8 ft. long	10 pc. 10 ft. long	10 pc. 12 ft. long
Transom	Oak, mahogany, or fir	$1\frac{1}{8}$ by 10 in. $1\frac{1}{8}$ by 12 in.	1 pc. 10 ft. long	1 pc. 10 ft. long	1 pc. 10 ft. long
Chines	Oak or fir	1 by 1 in.	2 pc. 14 ft. long	2 pc. 16 ft. long	2 pc. 17 ft. long
Keel (if rabbeted)	Oak, fir, or spruce	$1\frac{1}{4}$ by 3 in. $1\frac{1}{2}$ by 3 in.	1 pc. 12 ft. long	1 pc. 14 ft. long	1 pc. 16 ft. long
Keel (if built up)	Oak, fir, or spruce	$\frac{3}{4}$ by 3 in. 1 by 3 in. $\frac{1}{2}$ by $1\frac{1}{2}$ in.	1 pc. 12 ft. long 1 pc. 12 ft. long 1 pc. 12 ft. long	1 pc. 14 ft. long 1 pc. 14 ft. long 1 pc. 14 ft. long	1 pc. 16 ft. long 1 pc. 16 ft. long 1 pc. 16 ft. long
Battens and in-wales	Oak, fir, spruce, or yellow pine	$\frac{3}{8}$ by $1\frac{1}{2}$ in.	12 pc. 12 ft. long	12 pc. 16 ft. long	12 pc. 17 ft. long
Seat riser	Same as above	$\frac{3}{4}$ by $1\frac{1}{2}$ in.	1 pc. 8 ft. long	1 pc. 8 ft. long	1 pc. 10 ft. long
Bow stem	Oak	$1\frac{1}{4}$ by 5 in.	1 pc. 4 ft. long	1 pc. 4 ft. long	1 pc. 4 ft. long
Motor board, knee, breast hook	Oak or fir	$1\frac{1}{2}$ by 10 in.	1 pc. 6 ft. long	1 pc. 6 ft. long	1 pc. 6 ft. long
Corner brace	Oak	$\frac{3}{4}$ by 10 in.	1 pc. 3 ft. long	1 pc. 3 ft. long	1 pc. 3 ft. long
Sheer molding	Oak, ash, mahogany, or spruce	$\frac{1}{2}$ by 1 in. half-round	2 pc. 14 ft. long	2 pc. 16 ft. long	2 pc. 17 ft. long

H A R D W A R E

Item	13-ft. Hull	14½-ft. Hull	16-ft. Hull	Item	13-ft. Hull	14½-ft. Hull	16-ft. Hull
$1\frac{1}{4}$ -in. No. 6 flathead brass or gal. screws	8 gross	9 gross	10 gross	$5/16$ by 5 in. carriage bolts	4	4	4
$1\frac{1}{4}$ -in. No. 8	2 doz.	8 doz.	9 doz.	$\frac{3}{8}$ by 7 in.	2	2	2
$1\frac{1}{4}$ -in. No. 8	5 doz.	6 doz.	6 doz.	1-in. copper clout nails	2½ lb.	3 lb.	3½ lb.
2-in. No. 9	3 doz.	3 doz.	3 doz.	Glue, marine "C" or aviation	1 pt.	1 qt.	1 qt.
$2\frac{1}{2}$ -in. No. 9	2 doz.	2 doz.	2 doz.	Seam composition No. 2	½ lb.	½ lb.	½ lb.
$\frac{1}{4}$ by $1\frac{1}{2}$ in. carriage bolts	38	42	50	Paint	3 qt.	1 gal.	1½ gal.
$\frac{1}{4}$ by 3 in.	2			Varnish	1 qt.	1 qt.	3 pt.
$\frac{1}{4}$ by $3\frac{3}{4}$ in.		2	2				



This hull is one that fulfills a variety of needs because it can be built in three sizes and used with oars, an outboard motor, or an inboard motor and one of the new type stern drives

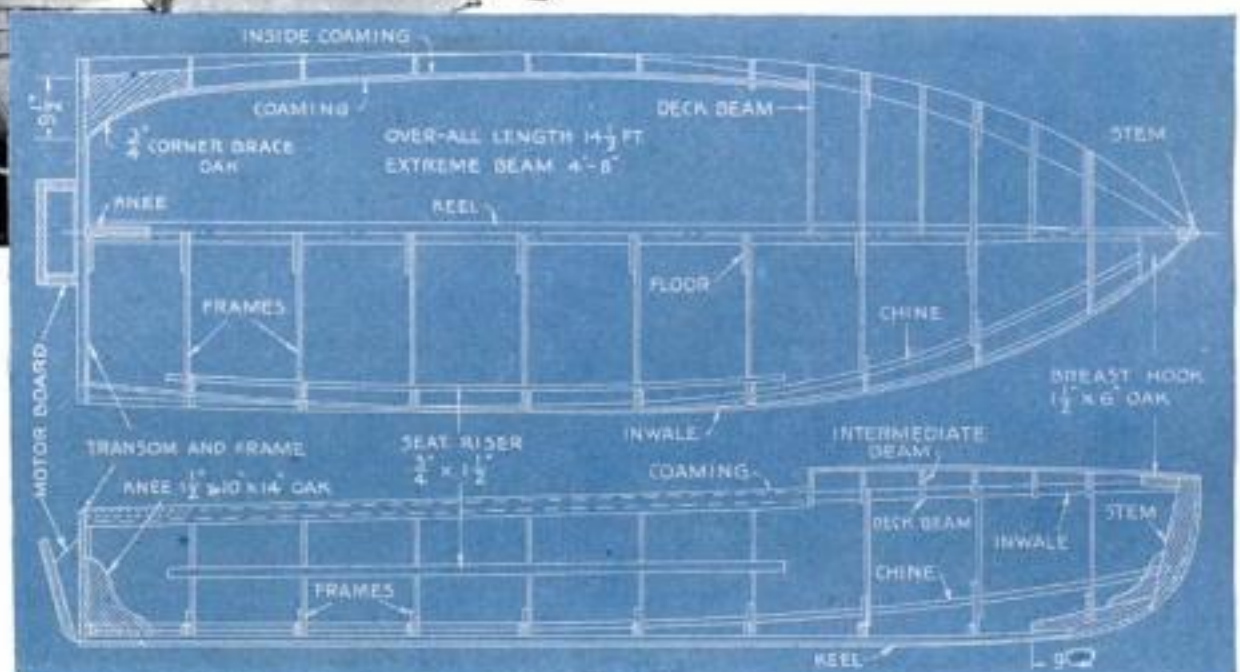
manently until the bottom planking is applied. This will facilitate beveling the keel.

The filler piece, however, should be attached temporarily to the keel. The assembled frames and keel are next clamped upon the form. A few screws may be used instead of clamps to fasten the keel, if preferred. Strips of wood are now nailed from the frames to the floor so as to hold the frames level. Nail pieces on the transom frame to hold it square.

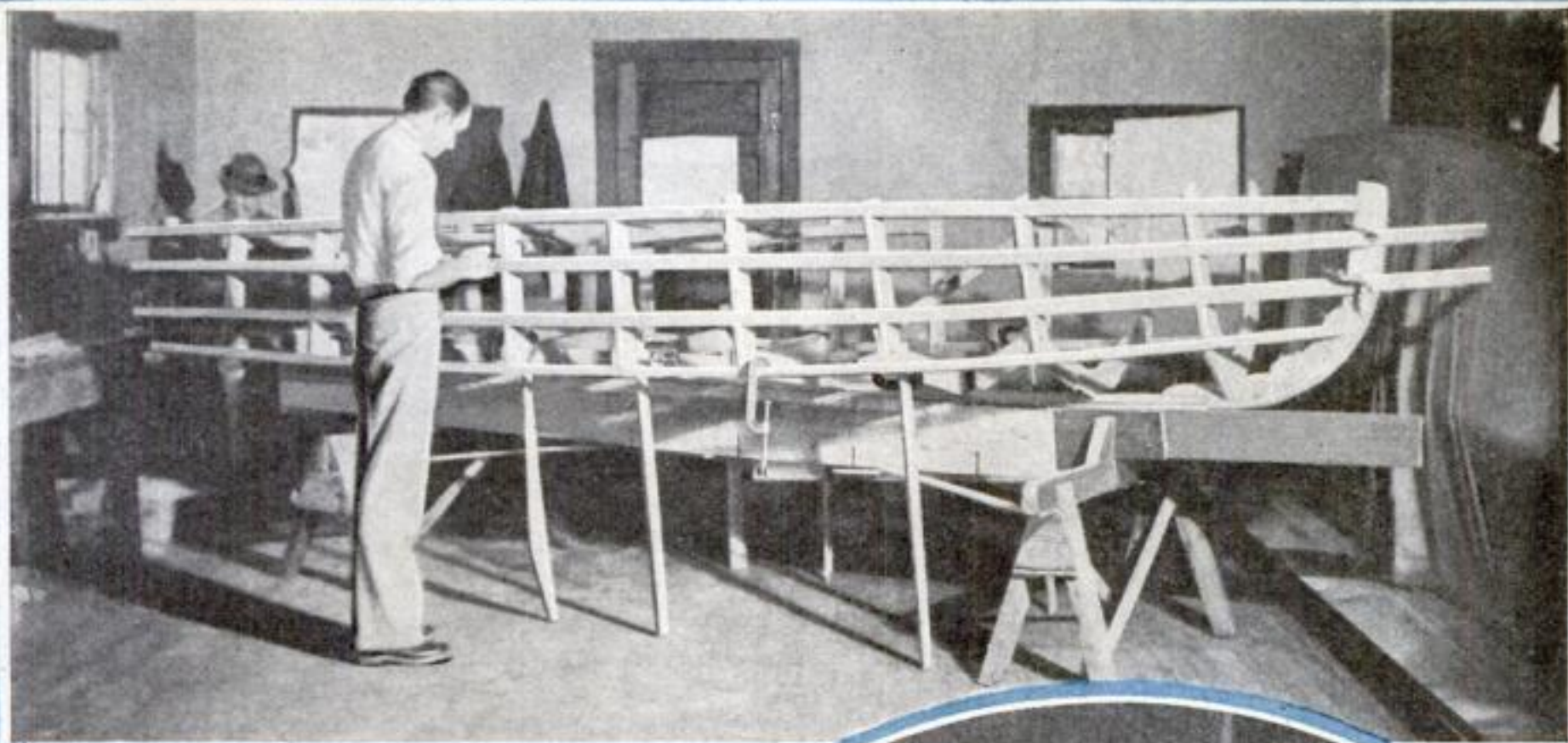
Attach the chines to each frame with

the side member the bevel to be cut. It will be necessary to bevel only the first three or four frames.

The frames are assembled on the keel upside down. Fasten each frame to the keel with two $1\frac{1}{4}$ -in. No. 8 flathead screws. Countersink these screws deeply, as the keel must be beveled off after the framework is completed. Fasten the stem to the keel with two $\frac{1}{4}$ by 3 in. carriage bolts. If a built-up keel is used, it will not be necessary to attach the filler piece per-



This is the assembly drawing of the 14½-ft. hull shown in the photographs on pages 75 and 77. Similar drawings, only larger and accompanied by full details, appear on each of the blueprints



one 2-in. No. 9 flathead screw. Fasten both sides simultaneously to prevent pulling the frame out of shape. Bevel off the chine at the stem and fasten with one 1 1/4-in. No. 8 flathead screw. Screw the inwale to each frame with one 1 1/4-in. No. 6 flathead screw.

The battens are next attached. The space between the chine and the inwale is divided equally into three spaces to fix the location of the two battens. Use a light strip of wood to see that these marks are in line. Cut off a small piece of the batten material and mark a center line on it. Let this center line coincide with the batten line just drawn on the frame. Mark the outline—that is, the width—of the batten on the frame, and chisel out the notch. The battens are fastened to each frame and to the stem with one 1 1/4-in. No. 6 flathead screw.

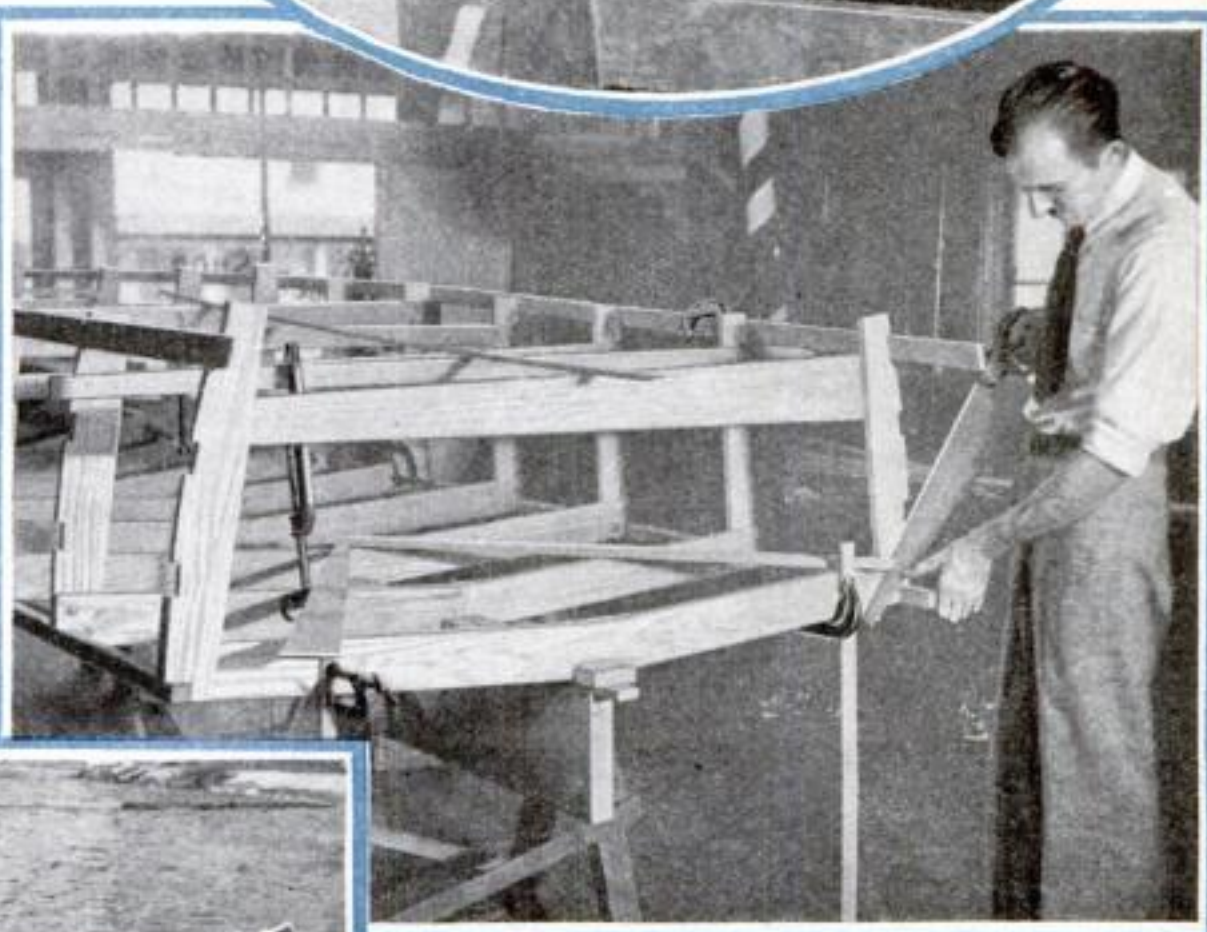
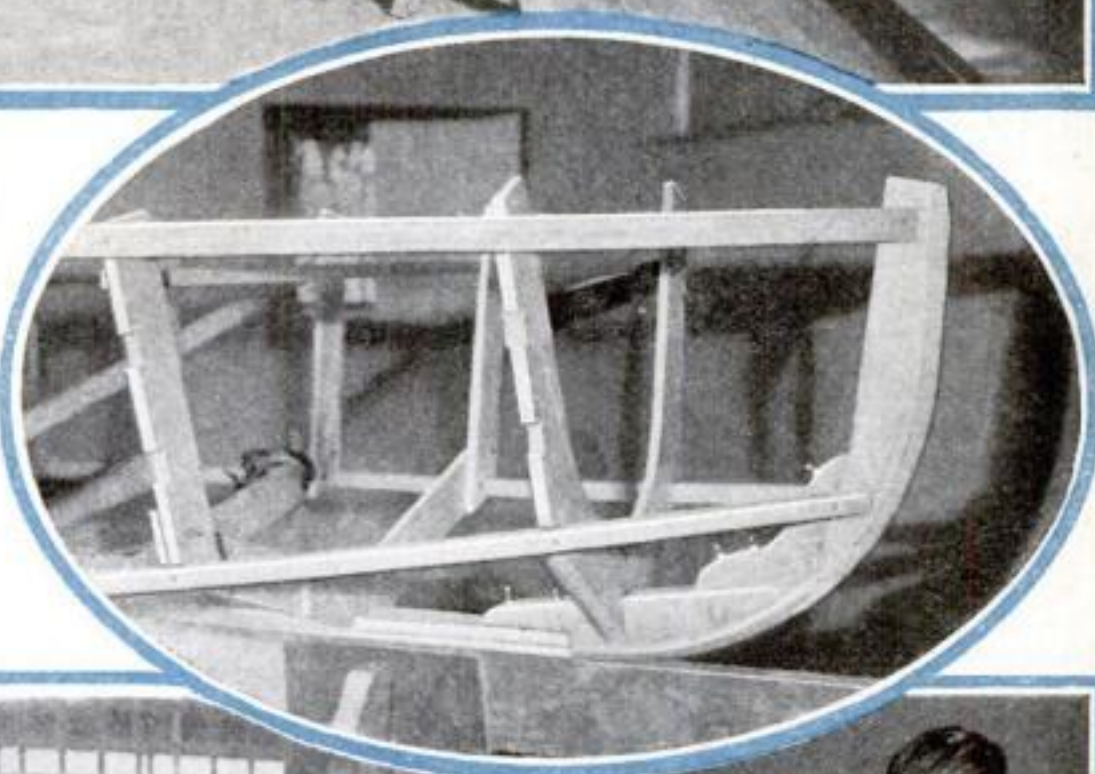
Trim off the battens, chines, and keel flush with the outside of the transom frame. Allow about 2 in. of the filler piece to project. Clamp the transom boards to the frame and mark and saw them to shape. Use three 3/8-in. dowel pins to fasten the two pieces together. Screw the transom boards to the transom frame with 1 3/4-in. No. 8 flathead screws.

The frame should now be trimmed and faired so that the planking will lie evenly.

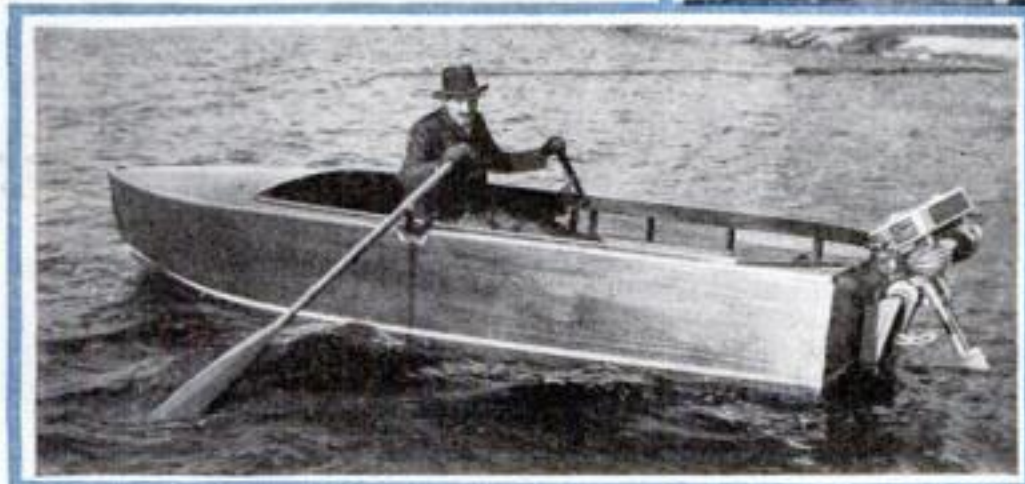
Instructions for planking, finishing, and painting will be given in the April issue.

Above: Fastening the battens in place. Note how the framework is set on the form and how securely it is propped up

At right: A view of the bow which shows the stem and the two forward frames. It illustrates well how the stem and keel are bolted firmly together



The framework looking at the stern. Here again can be seen the care which Mr. Jackson takes to brace the frame so that it will remain square and true. Notice the built-up keel; it is quite satisfactory and easier to make than a solid one

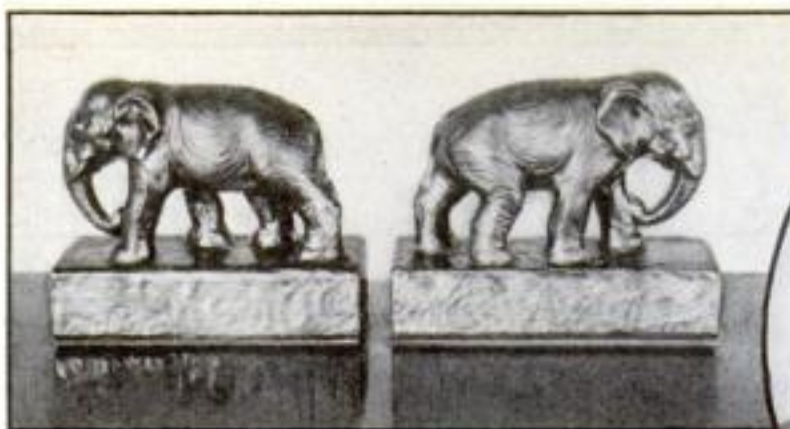


Using *Vagabond* as a rowboat. This photo has a wintry look because the hull was designed, built, and tested in the winter in order to get the plans ready for *Popular Science Monthly* readers in time for the coming season

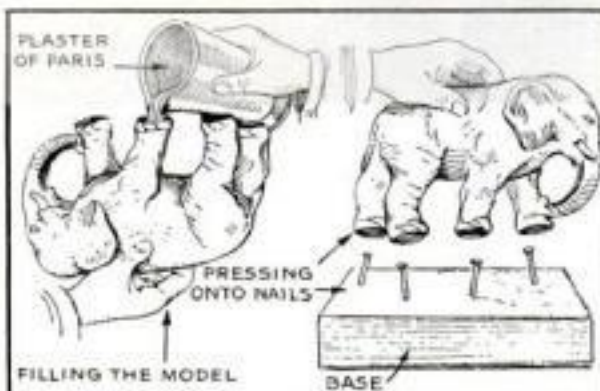
CELLULOID TOYS MAKE "BRONZE" BOOK ENDS

ALTHOUGH they appear to be genuine bronze, these book ends are nothing more than celluloid animals from the ten-cent store mounted on wooden blocks which are covered with a pulp made from newspapers. The materials required are two large celluloid animals (elephants or dogs are suitable), plaster of Paris, bronze paint, a small tube of dark brown artist's oil color, shellac, varnish, wax, newspapers, and two wooden blocks about $1\frac{1}{2}$ by 3 by 6 in.

Place the animal on the wooden block and mark the position of its feet. Drive a nail in the block for each leg, and bend the nails to fit up into the legs. Cut a hole in the bottom of each foot. Mix the plaster of Paris with water to the consistency of thick cream. Hold the animal upside down and quickly fill its body and legs with the mixture. Fit the nails of the base block into the legs, and hold both parts perfectly still for a moment until the mixture hardens. Prepare a newspaper pulp by tearing newspapers into small pieces, covering them with water, and boiling them into a thick mush.

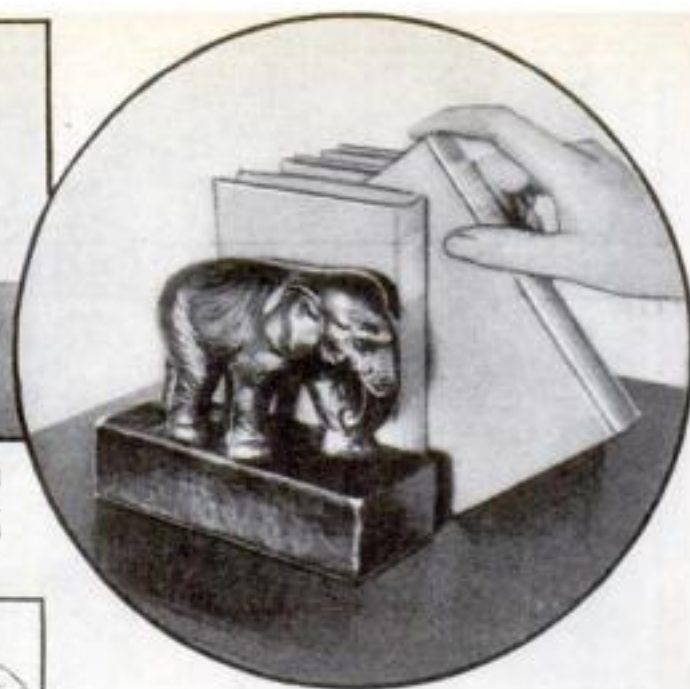


Toy celluloid animals filled with plaster of Paris and mounted on wooden blocks form these attractive book ends. They are finished to look like expensive bronze castings.



Cover the top, sides, and ends of the base with this pulp, which gives it a rough, stuccolike finish. Allow this to dry thoroughly, which will take several hours under ordinary conditions.

Shellac the entire surface and then



apply two heavy coats of bronze paint. Mix the dark brown oil paint with a little turpentine and cover the whole with a thin coat. When this is almost dry, wipe off the prominent places with a soft cloth, leaving the crevices and shadows brown. This shading gives a realistic bronze effect. Let the toning color dry overnight; then apply two coats of varnish; and finally polish to a soft luster with furniture wax. Glue pieces of leather, velvet, felt, or other soft material to the bottom of the base.—JOSEPHINE OWEN.

OLD TRUNK USED AS TOOL CHEST

A LARGE and useful tool box, especially for the mechanic who travels, may be constructed from a small trunk, provided it is in good condition and well reinforced. Saw cuts are made down each end of the box proper about 1 in. from each front corner, the cuts extending from the top to within 3 in. of the bottom. The front section is then cut away 3 in. from the bottom and hinged at the bottom to the remaining strip by means of two strap hinges. The front is further strengthened at all weak points with sheet metal. Three drawers are made of wood and reinforced with tin. These are divided into compartments for different kinds of tools. The drawers slide in and out on 1 by 1 in. angles screwed to the inner surface of the trunk ends. Pulls are screwed to the drawer fronts. The trunk tray is fixed permanently in place and also used for



This strong and roomy tool chest was made from an old trunk by hinging the front and adding three drawers.

tools. To close the trunk for traveling, the hinged front section is brought up and the lid is shut down and locked with the regular trunk snap fastenings and lock.—JOSEPH C. COYLE.

FLASHER UNIT AIDS IN TAKING SELF-PHOTOS

WHEN taking indoor flashlight photographs with a photoflash bulb, the one who operates the camera can get into the picture himself, if he wishes, by making use of an ordinary electric flasher unit designed for flashing lights on and off. One of these can be obtained in any electric shop and frequently at the electric goods counter of five-and-ten-cent stores. I insert this unit in the reflector socket, and then screw in the photoflash bulb.

The fixture is plugged into the house current, the switch on the lamp, of course, being turned off. This done, I focus the camera on the subject or group and leave a place for myself; then I turn out the room lights, switch on the flash lamp, and quickly take my place. Not until the flasher unit warms up, which usually takes about twenty seconds, does the current pass into the bulb and set off the flash.—JOHN BASKE.

MAKING A SHORT BOLT IN AN EMERGENCY

WHEN you need a short bolt in a hurry and do not have one in your supply box, try making a substitute from a sawed-off wood screw. Usually there is such a variety of wood screws on hand that you can select one of the proper diameter. When you have done this, cut off the threaded portion, and run the remainder into a die to form the threads. Hold the die in a vise or temporarily anchor it and its holder to the bench top with four nails as shown in the illustration below, and use a screw driver for turning the screw.—R. E.



Using a die fastened to the bench top for threading the shank of a cut-off wood screw.

Our New Furniture Construction Kit... *Coffee Table*

IN MAPLE OR MAHOGANY
ALL READY TO ASSEMBLE



OF ALL the coffee tables you may have looked at somewhat enviously in the homes of your friends or noticed on display in furniture store windows, you have never seen one that combines beauty, utility, originality of design, high quality, and low cost in the same degree as the table illustrated. And you can assemble one exactly like it without the slightest difficulty by making use of our new service organization, the Popular Science Homecraft Guild.

The Guild, which was formed to encourage more readers to take up the home workshop hobby, will send you, all shipping charges prepaid, a construction kit for the coffee table in carefully selected maple for \$7.15 or in the finest Honduras mahogany for \$8.15. The kit includes the completely machined wooden parts, the necessary hardware and dowels, three cans of special finishing materials, and cheesecloth for pads. In ordering, please use the coupon at the end of this article. You may either send the money with your order or have the kit

The beauty of this table is equalled only by its utility. It is of ample size, yet easily carried from place to place; and the top may be tilted up



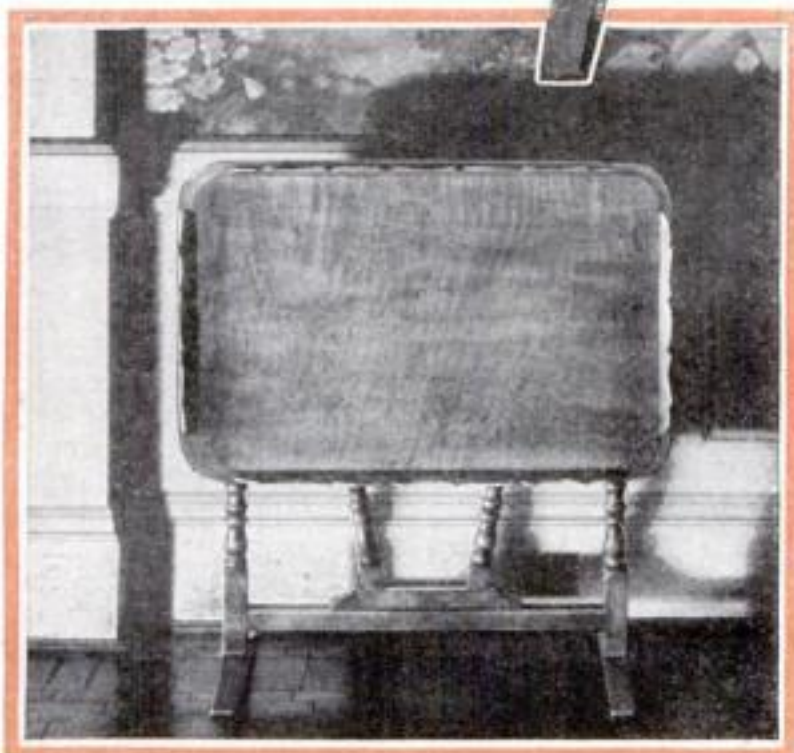
Above: A back view to show how the top is hinged and the way the gate closes. At left: The front view with the top tilted

shipped C. O. D., as you prefer. In either case the price is the same.

The table has a tilting top 19 by 28 in. and it stands 21 in. high. The design, which is by one of the greatest authorities on expensive custom-built furniture, has several distinctive features. Unlike a number of similar pieces, this one is not so large and heavily built that it cannot be carried conveniently from place to place and set up in any room or on the porch or terrace, wherever needed. It differs from a still larger number of coffee tables in that it is not so small as to be impractical for actually serving coffee and sandwiches. Another advantage is that when the top is tilted up, the table may be set against the wall out of the way and it becomes, because of the beauty of the wood from which the top is made, as much a decoration as if it were a purely ornamental tilt-top table.

The design is based on an unusual and ingenious application of the gate-leg principle of construction. A small pivoted gate opens to support the top and closes within the leg framework when the top is turned to the vertical position. Nothing of this kind will be found in ordinary furniture shops.

Although larger than the two previous projects offered by the Popular Science Homecraft Guild (P. S. M., Jan. '32, p. 76, and Feb. '32, p. 78), this table is even easier to assemble. The few essential tools are mentioned as need for them arises in the following instructions. It is also necessary to have on hand a few sheets of Nos. 1 and 00 sandpaper; a package of No. 000 or fine steel wool; a little cold water (casein) glue, (*Continued on page 118*)



Designed
and
Guaranteed
by the
POPULAR
SCIENCE
HOMECRAFT
GUILD

By Morton
C. Walling

Jig-Saw Puzzles

ARE EASY TO MAKE

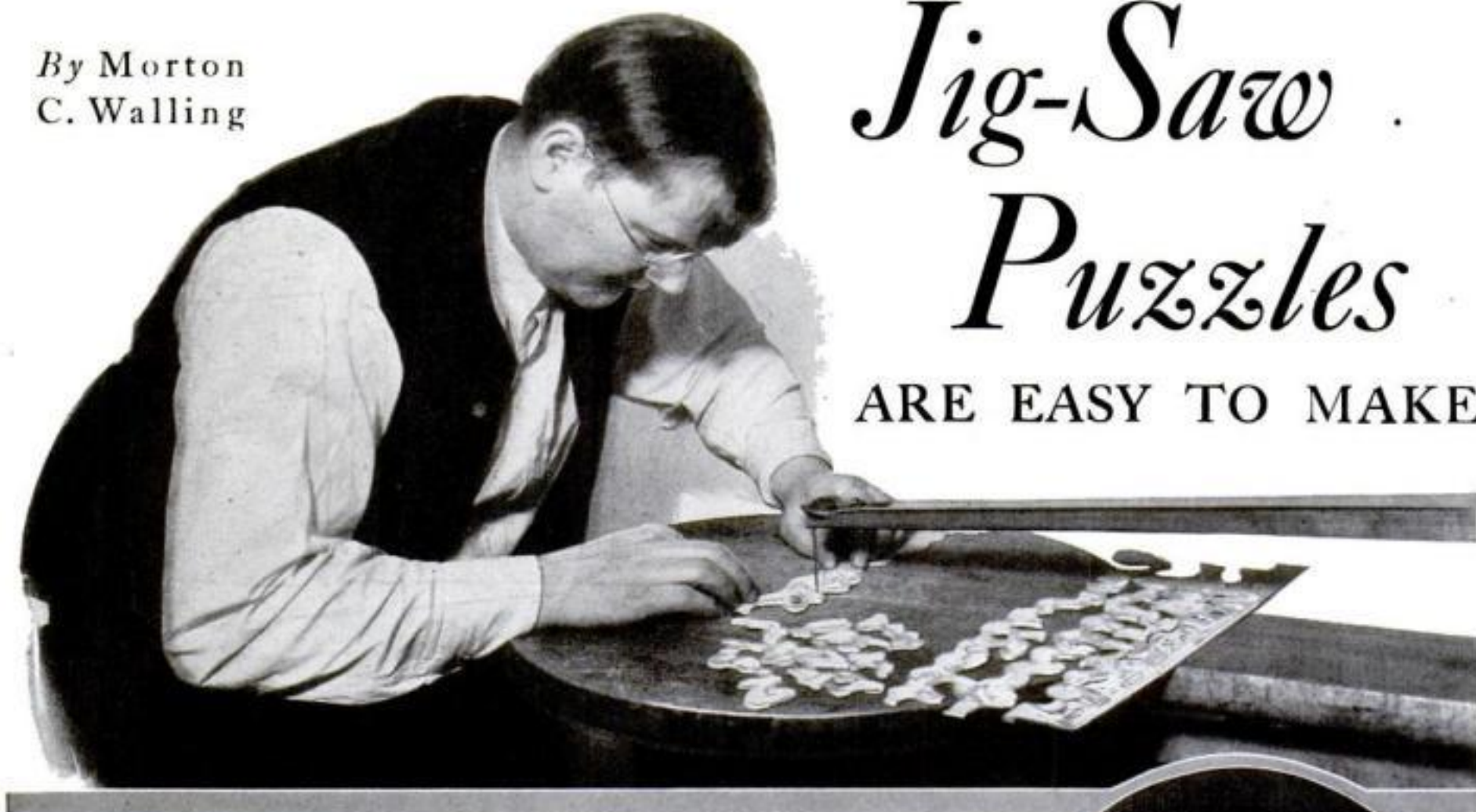


Fig. 1. Making the second cuts. If desired, the puzzle can be held together and each second cut made through all strips at once. Right: Burnishing the edges. Below: Applying the paste

JIG-SAWED picture puzzles, at the present time popular alike with children and grown-ups, offer the home craftsman an interesting form of recreation as well as a means of supplying many evenings of fun for the entire family. Little shop equipment other than a jig saw is needed, and the necessary materials can be easily obtained. In fact, where the amateur does a lot of shop work he will usually find suitable wood in his scrap heap.

When these puzzles were first introduced many years ago, they were cut from the lids of large cigar boxes, the trademark—generally a figure or group of figures in vivid colors glued to the top—serving as the puzzle picture subject. Now beautifully colored prints, excellent pictures in themselves, are used, and $\frac{1}{8}$ -in. three-ply wood forms the base material.

In selecting plywood, the amateur should give preference to birch and white-wood, obtaining stock that has the same wood for both outside plies. This stock is available in sheets 72 in. long and 24, 30, and 36 in. in width, costing about 15 cents per sq. ft. The puzzle pictures can be purchased in a large variety of suitable scenes and sizes from concerns dealing in colored prints. If you have any difficulty obtaining the materials for your puzzles, send a stamped and self-addressed envelope to the Home Workshop Department, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y., for a list of dealers.

Cut the plywood to a size 1 in. longer and wider than the desired dimensions of the puzzle. This will allow for a $\frac{1}{2}$ -in. border of waste wood which can be trimmed off when the puzzle is cut. In



selecting the portion of the stock to be used in the puzzle, see that there are no imperfections which may cause trouble when the wood is cut.

The picture is applied to the wood with wall paper paste, mixed to a workable consistency, beaten with an egg beater, and then strained to remove all lumps. To obtain good results, the paste must be absolutely smooth in texture and should not be watery.

Aside from the actual cutting, the pasting down of the picture is the most important operation. First, trim the picture to size and wet it with a dampened cloth. Then place it face down on a sheet of newspaper and brush a coat of paste on the back of the print, working from the center out and making sure that the corners and edges receive their share. When the back has been thoroughly coated, set it aside and allow the paste to become tacky before applying it to the wood. In placing the picture, locate it in the center of the plywood panel and smooth it with a moist rag. Inspect the print frequently.



Any large wrinkles or bubbles should be carefully smoothed out. The advantage in using wall paper paste is that any spots that may get on the front of the picture can be easily removed with a damp cloth.

When the picture has been thoroughly smoothed, place a weighted board on top, protecting the picture with paper, and set it aside overnight to dry.

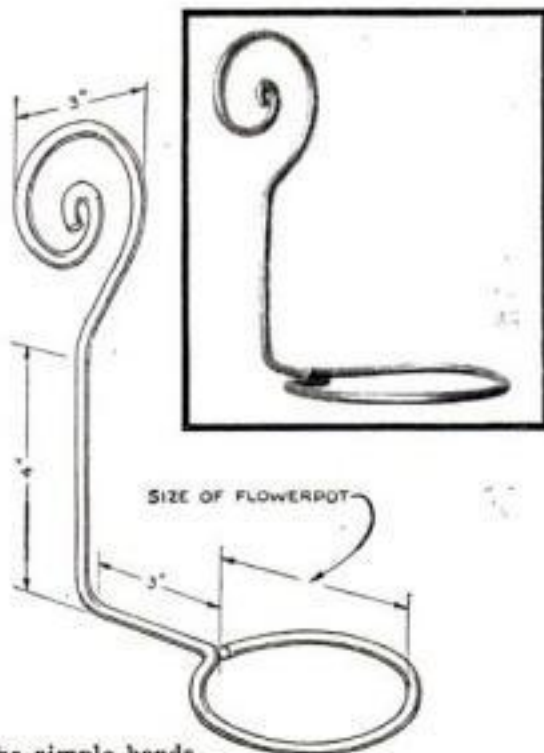
If the jig-sawed pieces, which make up the puzzle, are to fit snugly together, it stands to reason that they must be cut with a thin saw blade. Many puzzle makers use an American No. 0 blade .012 in. thick and having approximately 21 teeth to the inch, but the amateur will do well to obtain a "special" picture puzzle blade having some 38 teeth to the inch and being only .008 in. thick. The characteristics of both are shown in Fig. 2 (page 115).

In cutting the puzzle, first make a series of lengthwise cuts and then saw each long strip into small irregular pieces as shown in the large photograph of Fig. 1. Commercially a slightly different method is used, two sets of long cuts being made. First lengthwise cuts are made, each long strip being held in its place. Then the complete puzzle is turned 90 deg. and long crosswise cuts made through all strips. This speeds up the cutting but requires greater skill. (Continued on page 115)



STEEL ROD FORMS NOVEL FLOWERPOT BRACKET

SIMPLE and space-saving but decorative, this bracket for holding a small flowerpot or a vase may be made from a 3-ft. length of $\frac{1}{4}$ in. round cold-rolled steel. The only tools necessary are a vise and a small monkey wrench. About 2 in. at one end should be heated in the kitchen range or in any convenient way to facilitate bending the small loop for the wood screw by which the bracket is fastened to the wall or window frame. The remainder of the bending may be done cold without difficulty by using the vise and monkey wrench. To give an antique finish, paint the bracket black.—GEORGE BENDER.



The simple bends can be made with a vise and wrench

A CHEAP WAY TO CLEAN LACQUER BRUSHES

WHEN one uses quick drying lacquer, the proper way to clean the brush is with lacquer thinner, but this is expensive if enough is taken to do the work thoroughly. I find that a more economical method is to wash the brush well in gasoline before the lacquer has dried. This seems to precipitate the lacquer. Although the brush does not appear very clean, the lacquer will shake out in the form of a fine powder, leaving it clean. Of course, gasoline will not remove lacquer which has dried on the brush handle during the painting process.—EARLE D. SANSUM.

TOOLS KEPT HANDY IN HUNTING VEST

AN INEXPENSIVE canvas hunting vest fitted with shell loops is a handy and timesaving tool holder for one who uses many small tools as in radio construction and repairing, model making, and other craft work. A vest designed for 12-gage shells is best. Thirty-six or more small tools may be placed in the shell loops, and the weight is so evenly distributed that it is not noticeable. To hold pliers, the bottoms of two adjacent loops are cut out so that the handles will slip through them, as illustrated. When your work requires moving from place to place, you simply carry your small tools with you. This arrangement is particularly useful when doing work requiring the use of a step-ladder.—EDWARD THATCHER.



Thirty-six small tools can be placed in the shell loops

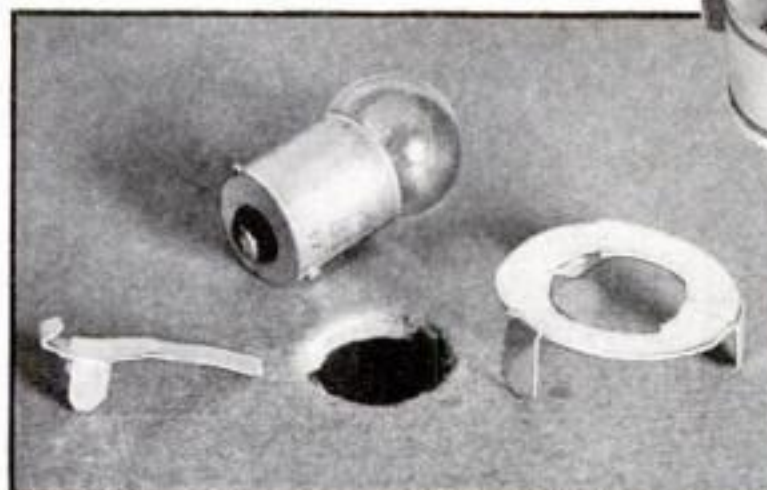
EASY WAY TO LIGHT A DOLL'S HOUSE

A DOLL's house will bring greater pride to its small owner if it is equipped with an electric lighting system. In order to make the installation of lights a simple and inexpensive matter, G. F. Prideaux, a Cleveland, Ohio, electrical engineer, has worked out a system that anyone can construct.

Automobile dash-light bulbs, lighted by a 6- to 8-volt battery or a toy transformer, are used, and are mounted on the ceilings of the doll's house. To make this easier, the ceiling material should be heavy cardboard. Each lamp socket is made from two pieces of tin cut as illustrated. One

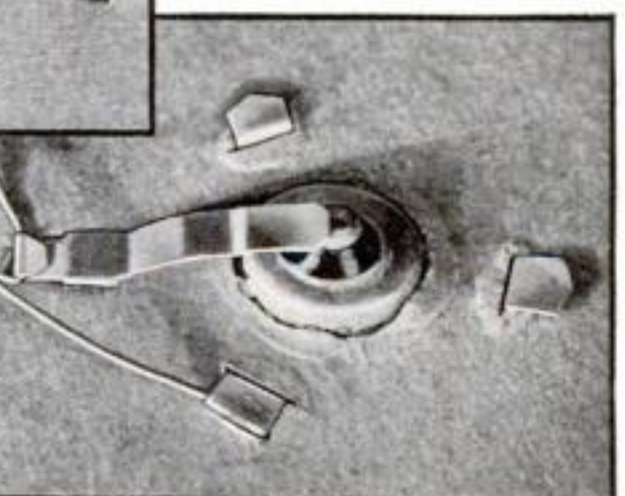


Paper shades will add to the effectiveness. These fixtures can be installed most easily before the house is fully assembled



Above: Pieces of tin from a can form the socket. At right: Rear view of completed fixture showing connections

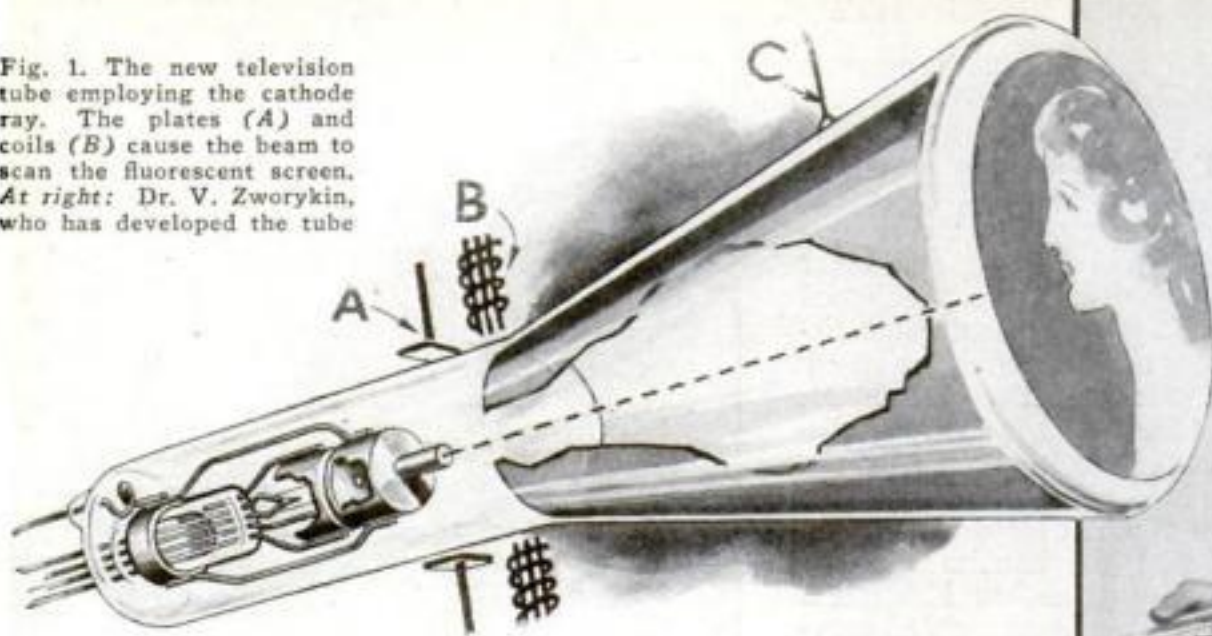
piece is simply a washerlike disk with three lugs and a hole just large enough to permit the lamp base to enter. Two notches are cut to allow the pins in the base of the lamp to pass by. The other piece, which is merely a strip with two lateral lugs, is used to provide a center contact. In each case the lugs are bent at right angles and pressed through slits cut in the cardboard; then they are bent over as shown. A hole slightly larger than the lamp base is cut in the cardboard beneath the socket hole. One wire is attached to one of the bent-over lugs on



the socket; the other wire, to a lug of the center contact piece. A simple paper shade completes the installation.

A similar system of illumination may be used to improve house models built as decorations or for display purposes in real estate offices.—WALTER E. BURTON.

Fig. 1. The new television tube employing the cathode ray. The plates (A) and coils (B) cause the beam to scan the fluorescent screen. At right: Dr. V. Zworykin, who has developed the tube



DON MARSHALL describes
the new method of

TELEVISION SCANNING *with the Cathode Ray Tube*

"SO YOU want to know how the cathode ray tube works?" said Don Marshall, my neighbor, who is a radio expert of long experience, when I asked him to outline the cathode ray system of television scanning. "You understand the principle of the ordinary radio tube, don't you, George?"

"Sure, that's easy," I replied; "the action of a radio tube is based on the flow of electrons from a heated cathode or filament to another electrode called the plate. On the way to the plate, the electrons pass through a grid which controls the passage of current. But what's that got to do with the cathode ray television tube?"

"Well," Don pointed out, "if you know the principle of the radio tube, you shouldn't have much trouble understanding the cathode ray tube. The general idea is the same. Of course, the physical construction is different and the electrons travel a greater distance and with greater velocity, but in operation it's just another vacuum tube."

"But, Don," I interrupted somewhat puzzled, "you've got to have light to get visible pictures. How can you get light from a bunch of invisible electrons moving around inside a glass tube?"

"Have you ever seen those large glass-like screens they use in hospitals to make X-ray studies of the organs in the human body?" Don asked. "Well, X-rays are invisible too, but when the rays strike these screens, which are made of a fluorescent material, they cause it to glow visibly. This same fluorescent property is made

IN THIS article, the ninth of a series relating an amateur's experiences in television, George Waltz tells how the newly developed cathode ray tube can be used to replace the bulky scanning disk and neon glow lamp in a television receiver

use of in the cathode ray tube. At the wide end of the tube there is a coating or 'target' of a fluorescent material called Willemite (a zinc ore). Whenever the electrons strike this target, it glows with a pale greenish hue at the point of contact."

"In other words, the fluorescent screen turns the radiant energy of the invisible

cathode ray into a visible spot of light?"

"That's it," Don replied with a nod. "Now let's study this sketch of a typical cathode ray television tube. [See Figs. 1 and 2.] At the narrow end," Don explained, indicating the position with the point of a pencil, "we have the filament, the control electrode, and a positive electrode which we will call the first anode. At the other end of the tube—that is, the wide end—we have the fluorescent screen and the second anode, which is a metallic coating on the inside of the glass." (Terminal of second anode shown at C, Fig. 1.)

"What does the control electrode do?" I asked.

"The control electrode regulates the discharge of electrons, just as the grid in a radio tube controls the passage of current."

"But as you have just explained it, Don," I pointed out, "the beam of electrons is projected down the center of the tube. How does that give you an image?"

"The beam is projected down the center of the tube just as I said, but when it reaches the deflecting plates (A) and coils (B) at the points shown in the sketch [see Fig. 1], the beam is made to travel back and forth and up and down in the usual scanning manner. You see," Don continued, "since the beam is made up of electrical particles, it can be attracted by magnetic and electrostatic fields. The coils, which set up the magnetic field, deflect the beam back and forth; and the plates, which supply the electrostatic field, cause a deflection at ninety degrees to the first. The combination of the two compels

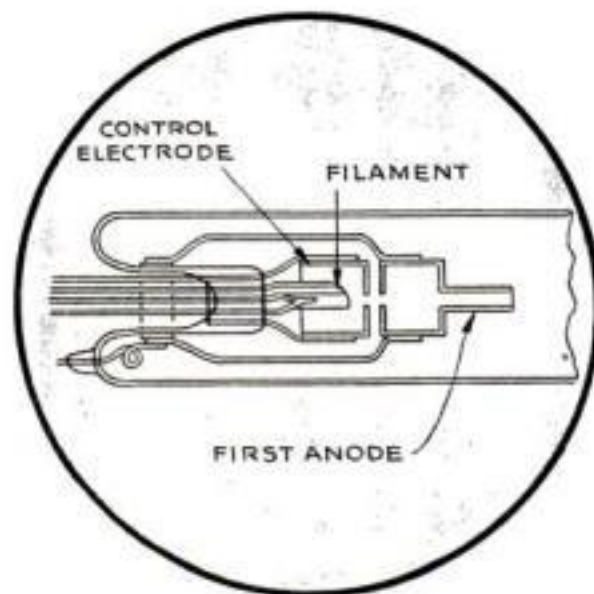


Fig. 2. Detail showing construction of the control electrode, first anode, and filament

the beam to travel back and forth over the entire fluorescent target."

"That gives us the scanning motion," I said, "but what about the 'lights' and 'darks' in the picture?"

"That's where the control electrode comes in," Don explained. "You see, by varying the intensity of the ray, the brilliancy of the glowing spot on the target is varied. The control electrode, which regulates the flow of electrons, is actuated by the incoming signal, so we then have a glowing spot on the target which varies in brilliancy according to the intensity of the electrical impulses sent out by the transmitter."

"How do they use the cathode ray tube at the transmitter?" I asked.

"At the transmitter," Don answered, "ordinary mechanical scanning methods can be used. The cathode ray tube has been used as a pick-up, but in its present form its use is limited."

"But I thought that the big advantage of the cathode ray tube in television was that it made possible images having one hundred and twenty scanning lines. Isn't it true that with mechanical scanning sixty lines are about the maximum that can be used and still keep the diameter of the disk within reasonable dimensions?"

"That's right," Don agreed. "The number of holes used in the scanning spiral does determine the diameter of the disk [see P.S.M., Sept. '31, p. 71], but at the transmitting end where space is not at a premium a large disk is no disadvantage. Then too, strong lights are available at the studio to give plenty of illumination for disk scanning. The advantage of the cathode ray is made use of at the receiving end where a large disk is undesirable."

"At that rate you ought to be able to receive programs intended for cathode

ELONGATED DOUBLE IMAGES RECEIVED ON A 60-LINE DISK FROM A 120-LINE STATION



Fig. 3. Sketch showing how a 60-line disk can be used in receiving a 120-line picture

ray television sets with a scanning disk," I suggested. "That is, of course, if you have a disk with one hundred and twenty holes and revolve it at the proper speed."

"Sure," was Don's reply, "and as far as that goes you can receive a one-hundred-and-twenty-line picture with a sixty-hole disk."

"How's that possible?" I asked. "I thought both disks had to match in order to receive an image."

"They should match," Don assured me, "if you want a true image, but if the re-

ceiving disk has a multiple of the number of holes in the transmitting disk, you can receive an image. You see a one-hundred-and-twenty-line picture received with a sixty-hole disk will give two elongated images in the usual image space. Now, if we mask off one of these images and place a mirror in front of the disk at such an angle that the reflected, projected single image will be broadened out to its natural proportion, we can receive a fairly good picture." (See Fig. 3.)

"How do they synchronize the cathode ray tube?" I asked.

"A complex signal current is sent out by the transmitter," Don explained. "At the receiver, the synchronizing frequency, which is separated from the signal impulse, is impressed on the deflecting coils. In practice, the de-

flecting plates are connected in parallel with a condenser which is charged by a constant current supply. When the condenser is charging," Don continued, "the electrostatic field set up by the plates moves the beam vertically while the deflecting coils supply the horizontal movement. When the condenser is discharged by an impulse between pictures, the beam returns to its starting point."

Another article on television by Mr. Waltz is scheduled for next month.

BOY'S DESK MADE FROM AN OLD CHEST

FROM an old chest of drawers and a few pine or whitewood boards, it is easy to make a serviceable and good looking desk that will be ideal for a boy's room.

Saw off one or more of the upper drawer



sections to obtain a height of about 30 in. Remove all of the original finish with the aid of paint remover, and sandpaper thoroughly. Then build up the upper section with $\frac{3}{4}$ by 7 in. stock for the sides, top, and shelves, and $\frac{3}{8}$ -in. boards for the vertical divisions. The door of the "strong box" in the center should be $\frac{3}{4}$ -in. material to take a strong lock. Dado and glue the divisions in place. The back is made of wall board and should extend 3 in. below the top of the chest to help brace the compartments.

The writing top may be built up by gluing narrow boards together. It should have 2 in. wide strips at each end to prevent warping. These should be glued and also fastened with long screws. Small wooden guides should be attached to the inside of the sidepieces of the upper section about $\frac{7}{8}$ in. from the bottom so that the writing top can be pulled out 5 or 6 in., and stops should be arranged to prevent its being withdrawn too far. Place three or four thumb tacks on the bottom of the writing top to insure easy sliding, and a pair of glass or metal knobs on top for pushing it forward and backward.

If a natural finish is desired, the true Colonial effect can be obtained by "staining" the wood with linseed oil and applying several coats of varnish, well rubbed down with pumice stone and oil.



Cutting off the top section of the chest of drawers to obtain a height of about 30 in.

If a modernistic design rather than Colonial is preferred, simply add a bank of narrow shelves at each side to obtain a set-back effect.—EVERETT EAMES.

CARVED CRUMB TRAY AND SCRAPER

THIS crumb tray and scraper set is a useful and ornamental addition to any dining service. There are no joints to give the beginner trouble, and it is not necessary even to follow the dimensions exactly. Use a good, straight-grained hardwood about 1 in. thick. Mine was made of black walnut, ornamented with simple chip-carved designs, and given a rubbed oil finish. Once the parts have been sawed to shape, the only tools needed are a block plane, a medium sized gouge and another smaller gouge, and a chip-carving knife, pocketknife, or small chisel (preferably a carver's skew chisel). The carving is nothing more than a series of ridges and valleys, each of the valleys being



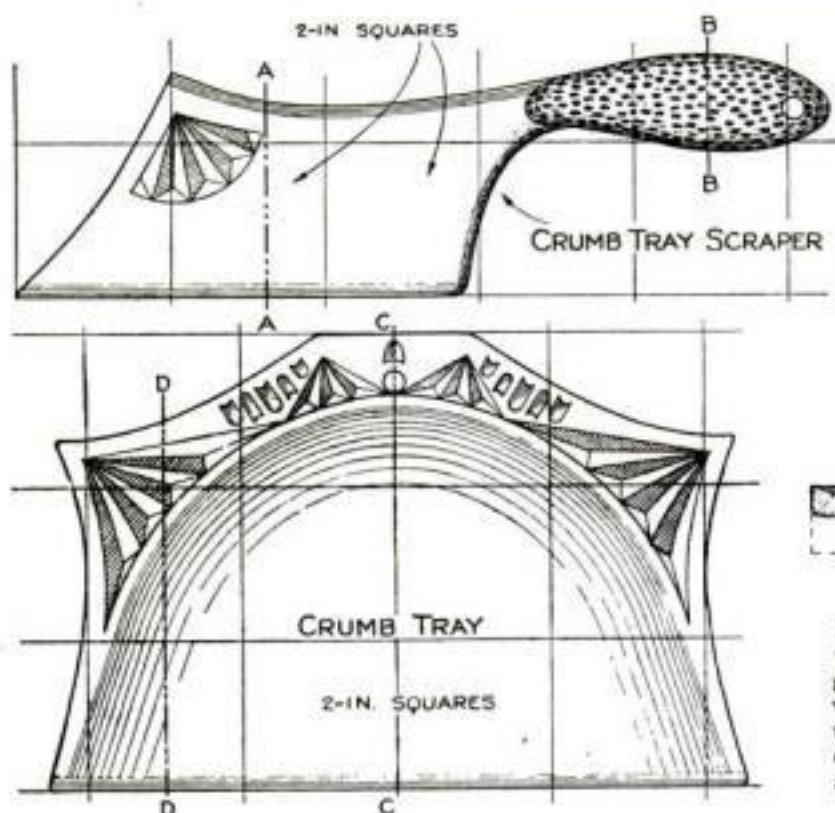
At left: Carving the ornament at the upper corner of the crumb scraper with a small penknife



Above: The completed set. The handle of the scraper is treated to represent buckhorn



Besides forming an attractive and useful addition to any dining service, the wooden crumb set is extremely light in weight



SECTION B-B

SECTION A-A

SECTION D-D

SECTION C-C

Drawings showing the shape of the tray and scraper and the suggested chip-carved design. The valleys in the design on both the tray and the scraper should be cut to a depth of about $\frac{3}{16}$ in. at the low point of each triangle

formed by taking out a clean-cut chip, hence the name "chip carving." First lay out the design in pencil. Then, for the triangular parts of the design, make cuts straight down to the desired depth on the lines which are to be the very bottom of the valleys. Next, working from the lines on each side which represent the top of the hills, slope the sides of the valleys down to the deep cuts first made. Plan how you are going to make each cut; then do it with as few strokes as possible, cutting with the grain. Getting the shape exactly right is not of so much importance as giving a decisive, clean-cut look to the work. A shallow groove is cut around each face of the handle of the scraper, and the part inclosed is lightly and irregularly chipped out with the gouge. The handle is then exposed to a flame and slightly charred. This process turns the wood black and smooths the edges of the chip marks so that the handle bears some resemblance to buckhorn.—WILLIAM C. CLARK.

CUTTING SMALL GLASS DISKS IN A LATHE

SMALL glass disks for pressure gages and other instruments are cut in our shop on a wood lathe. We screw a suitable board on a screw center (it could be fastened to a faceplate just as well). Next we set the dividers to the desired radius and start the lathe, holding one point of the dividers at the center and marking a ring on the board. The glass is placed over this ring and fastened with nails driven in so their heads grip the edges. Then we hold the glass cutter on the tool rest against the circle mark, which shows through the glass, and give the lathe a turn by hand.—F. H. L.



The tying of the knot can be simplified if the first loop is held in a vise and the second piece is manipulated under and over

Mounting the decorative metal knot is just a matter of bending over the four ends and forcing them into holes drilled in the wood



A KNOT tied in copper wire as shown makes an unusual ornament for small boxes, door panels, and other articles, particularly those made of oak, walnut, or other wood which is to be given an antique finish. Obtain two pieces of No. 14 wire about 4 or 5 in. long, and heat them to soften the copper. Form a loop with one piece, and weave the other in and out as illustrated. By anchoring the first loop in a vise and using pliers for manipulating the second piece, you can make the task easier. When the knot is formed, flatten it out and then high-light the raised portions with a piece of fine sandpaper. To mount the ornament on wood, drill four holes to receive the bent-over ends. The knot illustrated is the carrick bend, but the granny and square knots may be used.—W. E. B.

The Double Exposure Method of Taking Ghost Pictures and other Trick Photos

By

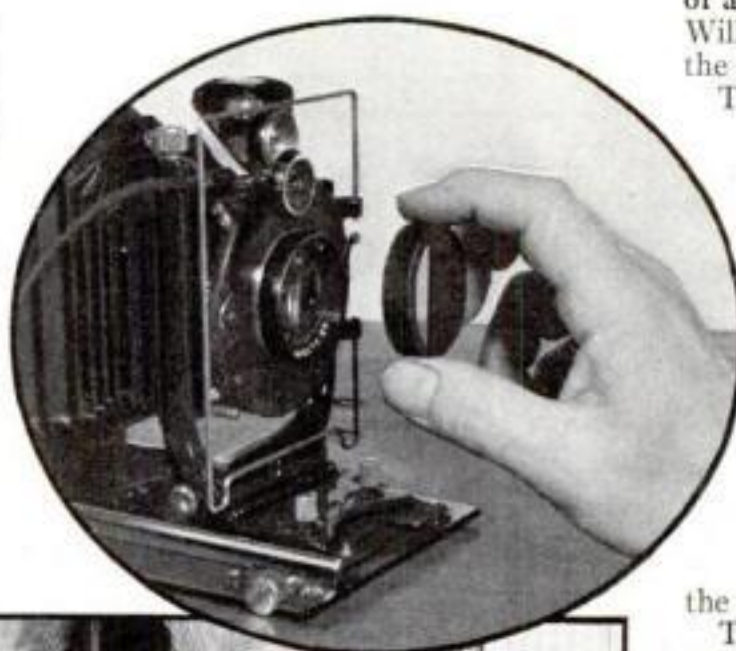
FREDERICK D. RYDER, JR.



Unless the camera lies, a ghost haunts this picture. In reality, the main picture was taken in the usual way; then a short second exposure was made of the "ghost" against part of the background

"OF COURSE a camera can lie!" I explained to a friend who brought up this point. "You can make it tell some whoppers by trick photography. If you want a demonstration, just come over some evening and I'll show you how to make the camera see the ghost of Napoleon or any other dead one strut across my parlor floor. All I need is a good picture of the dear departed."

In fact, ghost pictures are so easy that most beginners are quite likely to get a couple of them accidentally on their first few spools of film. Just forget to turn the key that winds in a new film and you are quite likely to get a



Another double-exposure shot that shows the same man seated in two different chairs and two different positions. In oval: The simple mask which makes it possible to take such photos

fine view of the ghost of Aunt Mirandy calmly strolling through the solid trunk of a tree, or the transparent shade of little Willie floating in a horizontal position up the side of a wall.

The picture at the top of this page is a typical example of the trick ghost picture. The camera is first set up firmly on a tripod, and the main picture is taken in the ordinary way. Then, without disturbing anything, the "ghost," dressed in light colored clothes or draped in white, is brought into the picture, and another very short exposure is given. If you give too long an exposure, the "ghost" will be much too substantial in appearance. What is required is a thin smoke-like image so that the details of the original exposure will show through.

There are scores of ways to introduce the "ghost" or "spirit of the departed" into the picture. Another method is to make the first exposure as already described and carefully mark on the ground glass just where you wish the ghost to appear. Then the ghost is set up against a black cloth background and the camera is adjusted so that the image appears in the desired place on the ground glass. The plate or cut film holder is replaced in the camera, and a short exposure finishes the "ghost" picture.

When the face of a person no longer in the land of the living is to be "materialized," the same procedure is followed, except that a photograph of the departed is silhouetted against a black background and focused on the ground glass in the previously determined position.

The size of the photograph is of no importance; if it is a small one, it can be placed close enough to the camera to appear in the picture as large as desired. Obviously, it is a simple matter to have two or more ghosts, either from live models or from [\(Continued on page 114\)](#)

A black and white oval photograph showing a person from behind, standing in a field of tall grass. The person is wearing a light-colored, short-sleeved shirt, dark trousers, and light-colored boots. They are holding a large, white, rectangular object, possibly a sign or a piece of paper, in front of their torso. The background consists of tall grass and bare trees, suggesting a rural or natural setting. The photograph is mounted on a dark album page.

With this knapsack, the load is carried high on one's shoulders in the least fatiguing position

THE so-called knapsack sold by most camping outfitters is about as much good in the woods or on a long trail as an extra pocket in a pair of pajamas. Most of them are hung from the shoulders by straps coming from two points and rest so low that the shoulders are drawn back into an unnatural position—the hardest way to carry a load on the back. They have no way of keeping small objects from spilling out, and if a blanket is carried it has to be strapped on top or carried over the shoulder.

A knapsack that eliminates these objectionable features was invented by Poirier and later improved with a flap of thinner material, which was added by the woodsmen using it. This Poirier, or Duluth, knapsack with the flap and draw string can be made easily in the home workshop at a fraction of the cost of the ready-made article without the flap.

In the table on page 117 are given the specifications of sacks of four different sizes. The one to be described in detail will be the 26 by 28 in. size, which is large enough to carry blankets, clothing, food, and dishes for one person for a three weeks' cruise.

Materials Needed. Two yd. 12-oz. duck, 30 in. wide, and $\frac{1}{2}$ yd. 8-oz. duck, 30 in. wide; five 1-in. buckles with tongue; one 2-in. D-ring; one 9 by 26 in. piece of strap leather; 1 box $\frac{3}{8}$ -in. copper rivets with burrs; 1 spool No. 40 thread, six $\frac{1}{4}$ -in. eyelets. If a tump or head line is wanted, add two 1-in. buckles and one 3 by 24 in. piece

of strap leather to your purchasing list.

Cutting. The 12-oz. duck should be cut 54 in. long and 29 in. wide. This allows 1 in. on each end for a hem and $\frac{1}{2}$ in. on each side for the seam. Cut the 8-oz. duck into two strips 9 by 30 in.

Sewing. Turn a 1-in. hem on each end of the sack piece. Fold so that the ends

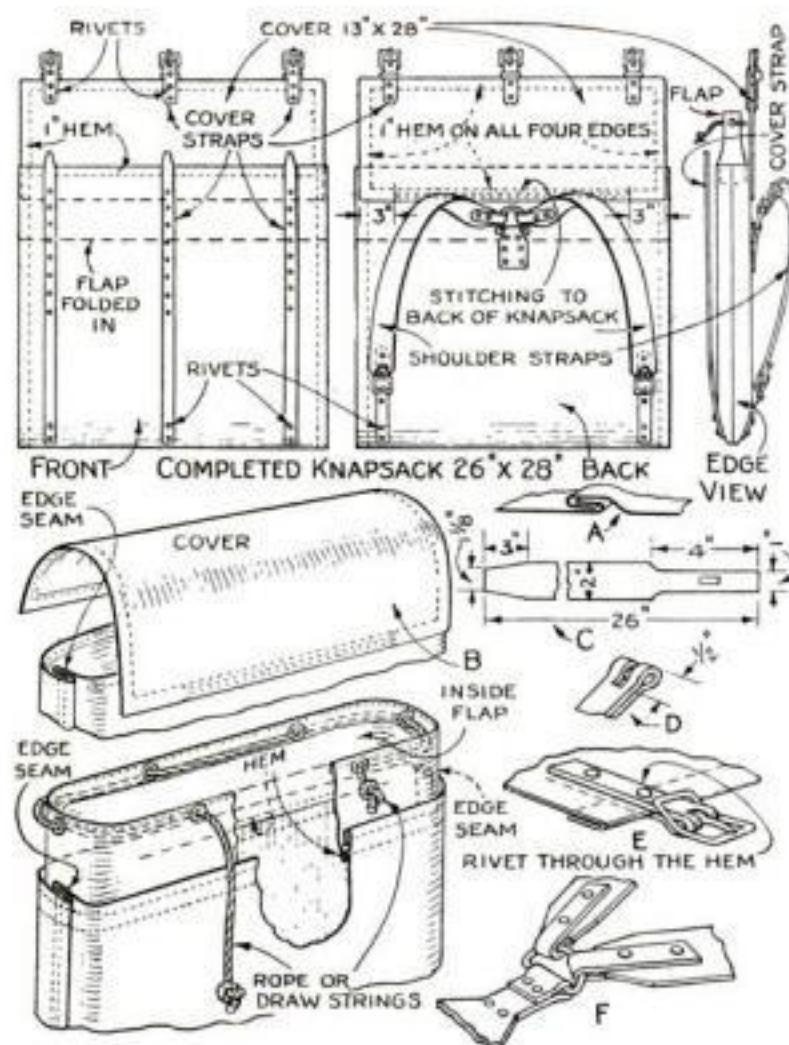
are even, with the hems on the outside. Stitch up each side $\frac{1}{2}$ in. from the edge. Fold these seams over and stitch again.

Turn a $\frac{1}{4}$ -in. hem on one edge of each of the 9-in. strips and a $\frac{3}{4}$ -in. hem on the other edge. The $\frac{3}{4}$ -in. hem will give added strength to the eyelets. Turn a $\frac{1}{2}$ -in. hem on one end of each piece and sew together interlocked, as shown at A in the drawings. Place this piece inside the sack, with the $\frac{1}{4}$ -in. hem toward the bottom, and measure for a tight fit. Turn a hem and sew the ends together interlocked as you did at the other end. Sew the flap into the sack 1 in. below the top, with the wide hem of flap uppermost.

Make a cover of the left-over piece of 12-oz. duck by turning a 1-in. hem on all four edges. Sew this to the back of the sack on the outside, but leave 3 in. on each end unsewed as shown at *B*. Stitch three times across and close the ends.

Coloring and Waterproofing. If the sack is to be colored (I prefer mine left white), get a package of the desired color dye and follow closely the simple directions given on the package.

The following method of waterproofing duck was given to me by C. S. Kimball, a chemist in Brooklyn, N. Y., and has proved very satisfactory. Two solutions are prepared—No. 1 by dissolving 13 or 14 oz. of white soap in 1 gal. of water; No. 2 by dissolving 2 lb. of aluminum sulphate in 1 gal. of water. Soak the fabric in No. 1 until (Continued on page 116)



The completed sack and details of cover, flap, and straps. A tump line for extra heavy loads can be added, if desired.

"Take my Tip, Charlie— you won't catch Cold half so often"



TESTS SHOW
Listerine
GARGLE

reduces Number of Colds 50%
reduces Their Severity 75%
reduces Their Duration 66%

Everywhere men and women are talking about the remarkable power of Listerine to keep them from catching cold, and to convert what threatened to be severe colds into mild ones. School teachers, guarding the health of their little charges, join parents in praise of the twice-a-day Listerine gargle.

Not Opinion, But Fact

And now, just to clinch matters, a number of scientific tests, conducted under medical supervision, show that public endorsement is based on scientific fact. They prove once again that to be efficient in the control of infection, a mouth wash must not only kill germs, but that it must do so without harm to tissue. Harsh mouth washes, authorities say, could not possibly achieve the results credited to Listerine, the safe antiseptic. Because Listerine, while it kills germs in the fastest time and reduces bacteria 98%, also heals tissue.

Succeeds Because Safe

Here, in brief, is an outline of some of the tests and their remarkable results:

204 people in normal health were under medical supervision in winter weather for periods ranging from 4 weeks to 4½ months. During this time, ⅓ of the number did not gargle full strength Listerine. ⅓ did gargle with it twice a day. ⅓ gargled with it five times a day. Now, see what happened:

One-Half as Many Colds for Garglers

Those who gargled with full strength Listerine twice a day contracted only ⅓ as many colds as those who did not gargle.

When Listerine users did contract colds, their colds were ¼ as severe and lasted only ⅓ as long as

colds caught by non-Listerine users.

Those who gargled with Listerine five times a day showed even greater resistance to infection, although not in proportion to the frequency of the gargle.

These results, brilliant as they are, do not mean that Listerine should be a substitute for the family physician. They *do* mean, however, that Listerine should be used systematically twice a day as a means of fortifying the oral tract against infection.

Prove it Yourself

All we ask is that you try Listerine and see how well it lives up to the claims we have made for it. Lambert Pharmacal Company, St. Louis, Mo.



also relieves
**S O R E
T H R O A T**

E F F E C T I V E B E C A U S E S A F E

Short Cuts for Car Workers

WIN A \$10 PRIZE

Each month we award \$10 for the best idea sent in for motorists. This month's prize goes to C. F. Blake, Oregon City, Ore. (Fig. 6). Contributions are requested from auto mechanics, both amateur and professional, and if published will be paid for.



Fig. 1. By carrying a vacuum bottle full of boiling water and pouring it over intake manifold as shown, it is always easy to start engine in coldest weather

ONE of the best known ways of starting a motor car in extremely cold weather is to pour boiling hot water over the intake manifold. Of course care has to be taken to see that the water does not get into the air intake openings of the carburetor. The only difficulty is that when you need the hot water most, your car may be far from a source of supply. An ingenious way out of this difficulty is to place a large vacuum bottle filled with boiling water in the car before you start out. Then, no matter how many hours your car has been standing or how cold the weather is, when you want to start for home the contents of the vacuum bottle poured over the manifold will assure a quick start.

Stop Air Draft

MANY types of car heaters consist of a sheet metal jacket over the exhaust manifold or over a portion of the exhaust pipe with arrangements so that air is forced over the heated surface and then into the car. Sometimes the flow of air is so fast that it does not pick up much heat

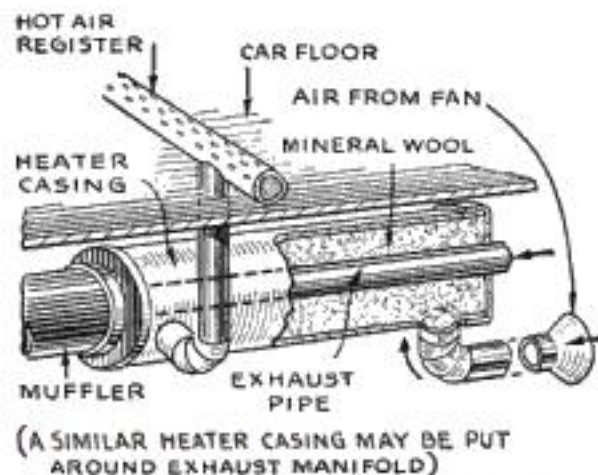


Fig. 2. Mineral wool stuffed into the jacket over exhaust manifold will stop a cold draft

and the resulting draft in the car is unpleasant. One way to slow down the flow of air and increase its heat is to stuff mineral wool into the jacket as shown in Fig. 2. The amount of material and the tightness of the packing will, of course, have to be determined experimentally.

To Repair a Spoke

FIG. 3 shows a way to repair a broken spoke in a welded wire wheel when the break is close to the rim. The first job is to chisel off the stub of the spoke remaining on the rim. Then the hub cap is removed and a 15/32-in. hole drilled in center line of the spoke. The end of the spoke is threaded with 1/4 by 20 die. After that, a 7/16 by 1 1/4 inch cap screw is drilled lengthwise and tapped with a thread to fit the end of the spoke. The bolt is screwed on tight. The job is finished by soldering around the bolt and filing to the contour of the others. After painting, the repaired spoke was not noticeable. Soldering is not absolutely necessary, but it hides the repaired spoke and prevents loosening by vibration.

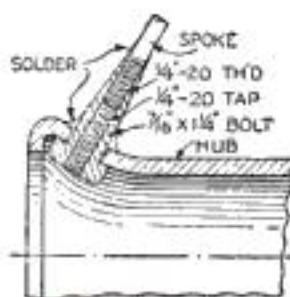


Fig. 3. This diagram shows how a wire spoke, broken close to rim, can be mended so as to be unnoticeable

Lock in Plain Sight

TO BE effective, an auto lock must either be so strong that it cannot easily be forced, so carefully concealed that the thief cannot locate it, or so obvious that he is sure to overlook it. Fig. 6 shows an excellent lock of the third class. A double contact socket is mounted in a prominent place on the dash. The wire supplying the ignition circuit is cut and the two ends attached to the socket. Then a double contact plug is short-circuited with a short piece of wire. When you want to run the car, insert the plug in the socket. Remove the plug when you leave and a thief attempting to steal the car is sure to think that the socket has no other function than to permit the use of a trouble light.

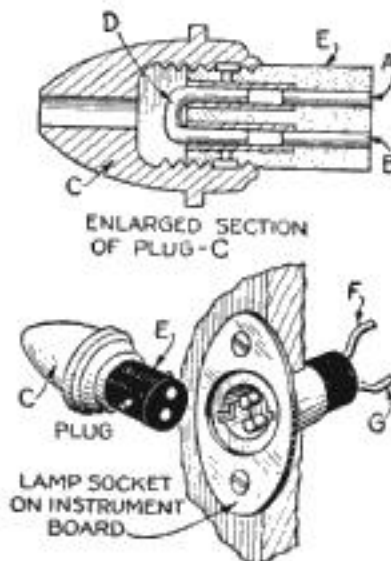


Fig. 6. Here is an auto lock so easily seen a car thief will think it is merely a socket

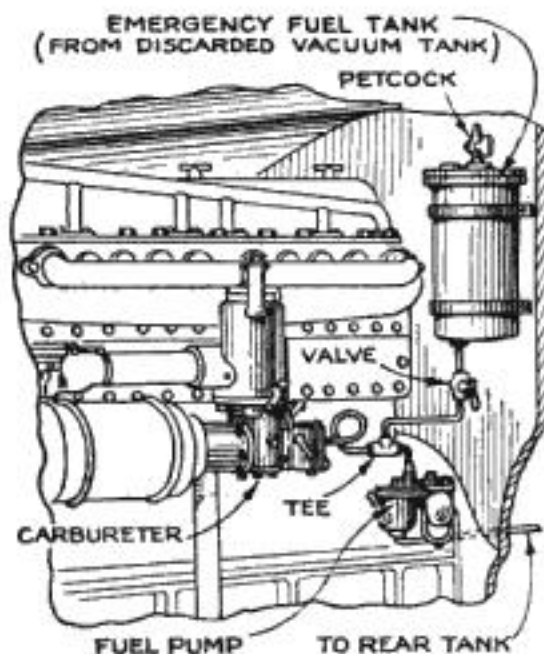


Fig. 4. A tank on the dash can be connected with fuel pump as emergency gas supply

An Emergency Tank

FEW car owners realize that the characteristics of the fuel pump on the modern auto are such that the fitting of an emergency gasoline tank is easy. All the equipment you need is a discarded vacuum tank. Remove the "insides" from the vacuum tank and mount it on the dash at any convenient point as shown in Fig. 4.

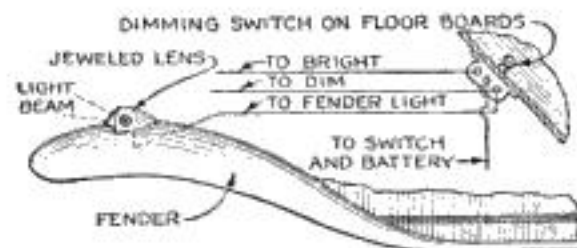


Fig. 5. Bulbs on the fender can be used to show whether bright or dim lights are on

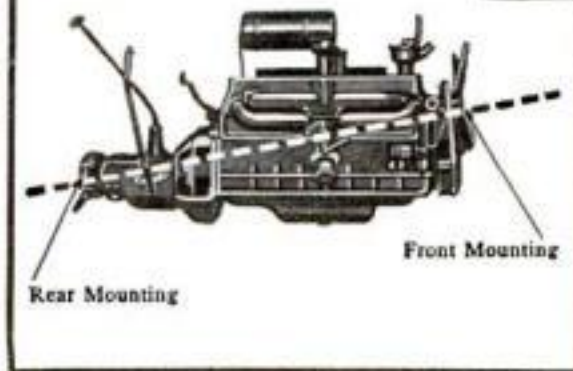
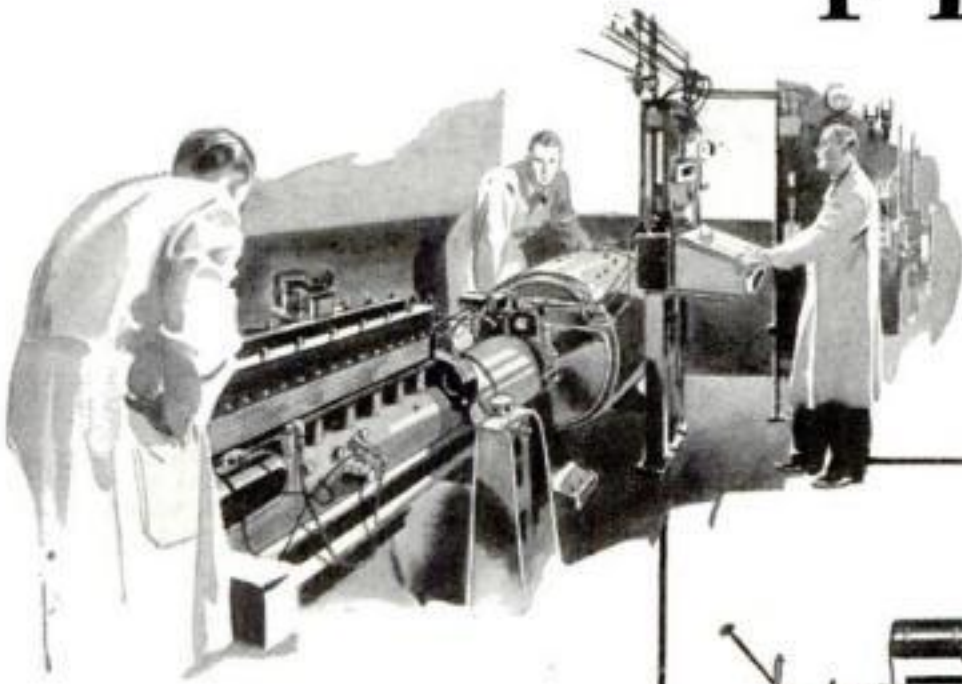
Plug all holes in top but one; fit a petcock to that one. Put a tee in the fuel line between the carburetor and the fuel pump and connect it, by way of a shut off valve, to the vacuum tank. To fill the spare fuel tank, open both the valve and the petcock while the motor is running.

Light Indicator

IT IS often difficult to tell, on brightly lighted streets, whether the bright or dim headlights are on. Fig. 5 shows a way to fit an indicator that will tell this. Clearance lights are mounted on the fenders and connected in parallel with the filaments that project deflected beams. When these lights are on dims are on.

What is this FLOATING POWER?

PATENTED AND FULLY PROTECTED



FLOATING POWER is the most talked-about new thing in the motor car world.

Everybody is interested—asking questions—asking what it is and what it does.

Floating Power is not just another name for a certain quality of power—it is engineering's final triumph in the long, hard fight against vibration.



Automotive engineers have grappled with vibration for years. Flywheels and crankshafts have been balanced almost to a hair. Pistons and connecting rods have been perfectly matched. Vibration dampeners have been employed. Every known means of securing mechanical precision has been used in efforts to reduce and minimize vibration. Years ago Chrysler Mo-

tors engineers developed rubber engine mountings. Those mountings did much to control and subdue vibration—and they are still being used by many manufacturers.

But Chrysler Motors engineers are never satisfied. They kept on working. They kept on endeavoring to wipe out vibration *entirely*. Finally, their efforts led to the discovery of Floating Power. Floating Power is an entirely new *kind* of engine suspension.

The power plant is supported at two points—front and rear—on mountings of bonded rubber and steel. These mountings are so located as to support the engine in perfect balance.

Power impulses from the engine never reach either the frame or the body—because the im-

pulses are absorbed at their source by the slight movement of the engine in its Floating Power mountings.

The result is an entirely *new kind of performance*.

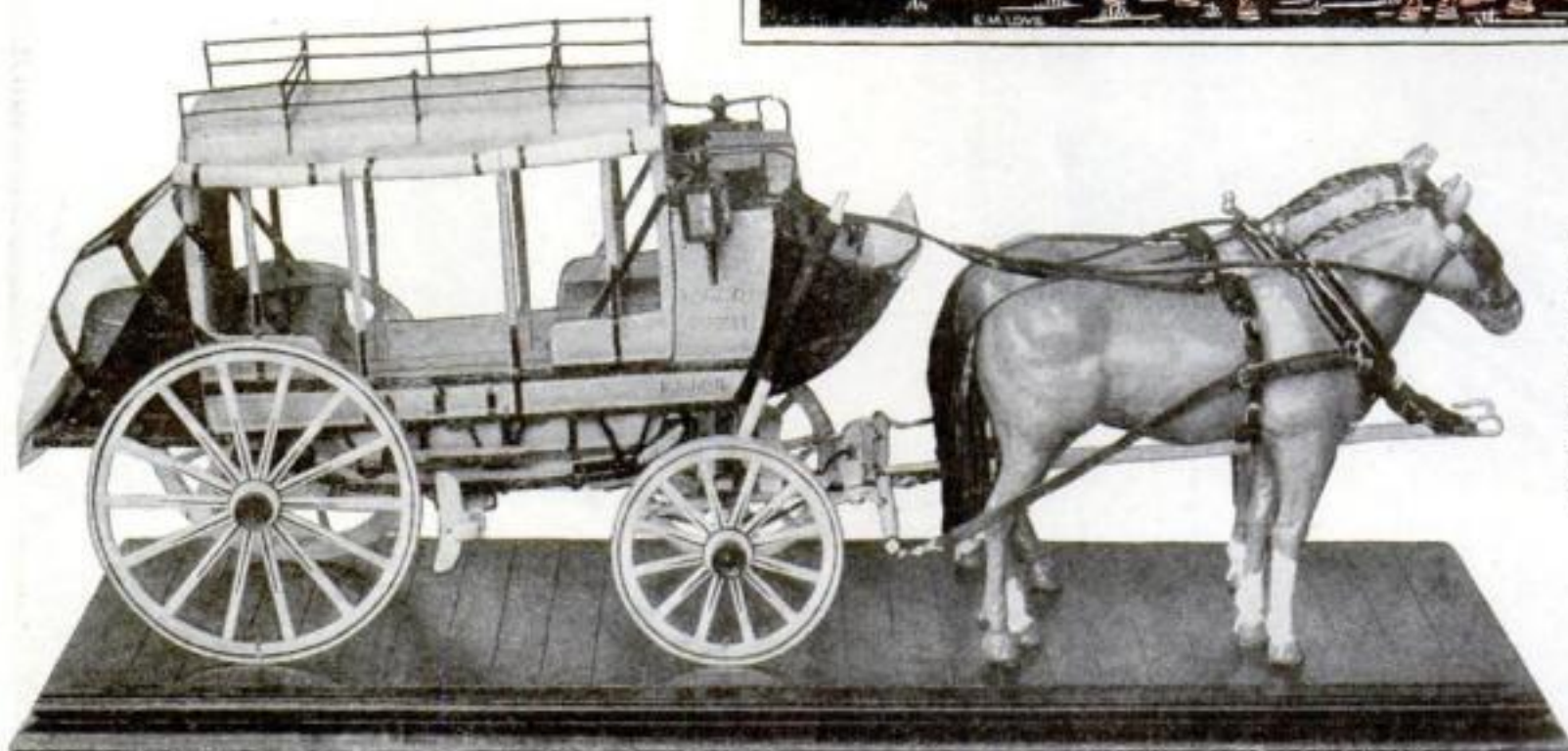
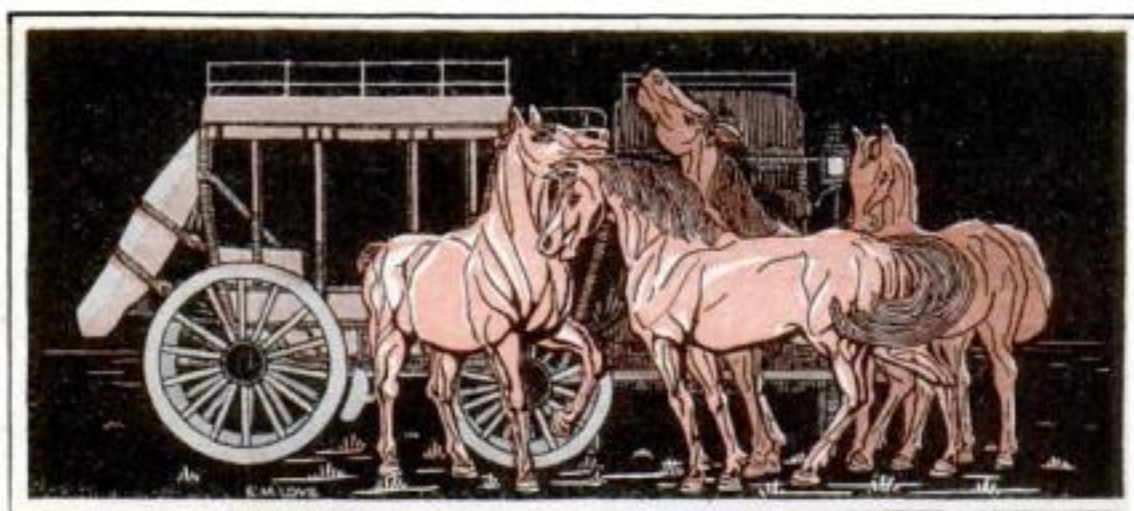
Floating Power creates a fascinating new “feeling” in motoring—a new smoothness impossible to describe, but noticeable the moment you take the wheel.

Floating Power is patented and used exclusively on the cars of Chrysler Motors—Plymouth, Dodge, De Soto and Chrysler.

Previously there had been nothing like Floating Power—in principle or in results. Drive one of these cars and learn for yourself the wonderful experience of driving at all speeds without feeling *any* vibration.



ATTRACTION as our new Cody coach model is in itself, it can be made still more picturesque by adding a pair of properly harnessed horses. Each horse is built up of eight easily carved blocks of very soft balsa wood



How much more reasonable this model looks, with standing horses, than the average commercial stagecoach model, which so often appears to be careening along the mantelshelf behind trotting horses without either driver or passengers

HORSES and HARNESS *add a realistic touch* to our *Cody Coach Model*

By
EDWIN M. LOVE

EXCEPT for a few details which remain to be added to the body of our "Buffalo Bill" Cody stagecoach model, we are ready to start carving the horses and making the harness. As announced in the two previous articles in this series (P.S.M., Jan. '32, p. 73; and Feb. '32, p. 86), all the necessary full size drawings for both coach and horses can be obtained by sending for Blueprints Nos. 144, 145, and 146 (see page 110). Any unfamiliar terms in the following instructions may be identified by referring to the blueprints.

BOOT EQUIPMENT. *Chains:* Obtain 1/16-in. silver chains from a five-and-ten-cent store to hook up the floors.

Leather Sides: Glue over the chains and around the rods, and to the floor edges, not forgetting the cardboard finishing irons there.

STEPS. Drive pins through the brackets into the side boards.

SEATS. These are wooden blocks covered with leather.

PAINTING. The carriage is yellow, with black stripes on the felloes and hubs. The irons may be made black, if desired, but plates subject to wear should be brightened with aluminum paint. The body is red, with each side panel and seat end outlined with gilt stripes. Paint

the side straps, wooden boot-side front edges, side-board top edges, railings, lamps, and brackets black. On the boot sides paint in gilt the words "W. F. & CO. EXPRESS," and on the side boards below "U. S. MAIL." Paint the insides of the seat ends, side boards, and fore boot flat blue-gray, and the top of the hind boot floor the same color.

COVERING HIND BOOT. Make the hind boot cover, fill the boot with blocks of wood to imitate baggage, and buckle the straps.

SIDE CURTAINS. These are rolls of muslin bound with leather straps and glued and pinned to the coach top.

BASE. Cut the five-ply hardwood 6 3/4 by 19 1/2 in. Cross-score lines 3/4 in. apart with a 1/8-in. gouge, to give the effect of a plank driveway. Miter a hardwood molding around the edges, keeping it 1/16 in. below the surface of the "planks." Stain the center dark brown; then shellac and wax it. The molding is finished with black enamel, the last coat thinned well with turpentine to reduce the gloss. Mount the carriage on the base with small steel screw hooks placed so as to clasp the wheel felloes from the inside.

THOROUGHBRACES. Use four thicknesses of black shoelaces slung between the shackles with pins for bolts. Stretch

them so that the undersides of the laces, when supporting the body, are a little below the tops of the reaches.

SWAY STRAPS. These are like wide hame straps.

SUNDRIES. Make the whip socket and mount behind the lamp bracket at the driver's side. Line the tray back of the seat with muslin.

HORSES. *Roughing Out:* The blocks may be of almost any kind of wood, but balsa, since it cuts like cheese, is the easiest to use. Trace the two profiles (Blueprint No. 146) on each piece, and saw out. Pin the waste parts back in place so that the shape may be sawed from the other direction. Glue the pieces together, reinforcing the joints with pins and nails. To give lifelike attitudes, turn the heads a little toward the inside and have the head of one horse higher than the other. The feet of one horse, viewed from the side, are fairly close together, while the hind feet of the other are well separated.

Carving: Use a razor-sharp pocketknife, a veining (carver's) gouge, and such other tools as are convenient. Composition wood may be used to correct mistakes.

Painting: The writer painted his horses medium reddish brown, with white spots on the nose and legs. The mane, tail, and such features as are not white, are bluish-

ANSWERING YOUR QUESTIONS

about ULTRA-VIOLET

SINCE the dawn of civilization, men have instinctively turned to sunlight for its beneficence. Today we know that the ultra-violet rays in sunlight are especially beneficial to health.

The action of ultra-violet rays upon the skin develops Vitamin D, which assists in promoting the growth of strong bones and teeth in children, and helps both children and adults to resist disease.

You will find here the answers to many of your questions regarding ultra-violet.

Question—Will a MAZDA Sunlight Lamp produce sunburn?

Answer—Yes, if the exposure is great enough. Twenty minutes' exposure at a distance of two feet directly under the bulb of the MAZDA Sunlight Lamp (Type S-2) will produce sunburn on portions of skin ordinarily covered by clothing (back, chest, upper arms, etc.). The sunburn will not be noticeable until several hours after the exposure.

Question—Is sunburn necessary in order to obtain benefit from ultra-violet rays?

Answer—No. Sunburn is *not* necessary. For best results you should get a little ultra-violet every day.

Question—How long may I remain under a sunlamp?

Answer—At 24 inches, it should take about 20 minutes to cause a mild sunburn on back or chest. At twice the distance it will take four times as long to get sunburn. In case of a ceiling or wall fixture, where you are five or six feet from the bulb, you can remain under a MAZDA Sunlight Lamp (Type S-2) for hours without sunburn. But remember—even then you are receiving beneficial ultra-violet radiation. Sunburn is *not* necessary.

A GUARANTEE OF RELIABILITY



This emblem is a guarantee that the fixture to which it is attached has been tested and approved for illumination and ultra-violet effectiveness when used with the MAZDA Sunlight Lamp (Type S-2). Purchasers should look for this emblem when buying fixtures for the MAZDA Sunlight Lamp.

Question—Is it necessary to protect the eyes with goggles under a sunlamp?

Answer—No. The MAZDA Sunlight Lamp (Type S-2) is as safe as sunshine. Special glass in the bulb shuts out the short waves which might be harmful to the eyes. You can read or sew under this lamp with perfect safety.

Question—Is it harmful to look directly into the bright light of the bulb of the MAZDA Sunlight Lamp (Type S-2)?

Answer—It is harmful to look directly at any bright light.

Question—How often should I use a sunlamp?

Answer—Daily if possible. That is why many people have a ceiling or wall sunlight fixture in the bathroom—so that every member of the family gets a little ultra-violet every day. Sunburn is *not* necessary to health.

Question—Why can't I get all the ultra-violet I need from outdoor sunshine?

Answer—Because you don't spend enough time in the sunshine, for one thing. Ordinary window glass shuts out ultra-violet rays. And in winter, outdoor sunlight gives you very little ultra-violet, even on a bright day.

Question—Should the aluminum cap be removed from the bulb of the MAZDA Sunlight Lamp (Type S-2)?

Answer—Never. The cap reflects heat back into the bulb and increases the ultra-violet output. This cap also reduces direct glare from the lamp.

Question—What is the difference between the MAZDA Sunlight Lamp (Type S-2) and the MAZDA Sunlight Lamp (Type S-1)?

Answer—The MAZDA Sunlight Lamp (Type S-1) is a high-powered source of artificial sunlight. The MAZDA Sunlight Lamp (Type S-2) is milder, but just as effective when used at the proper distance.

THE NEW MAZDA SUNLIGHT LAMP (Type S-2)



This lamp can be operated at an average cost of less than 1½¢ per hour. It operates on alternating current, and only in fixtures specially designed for its use.

Note: The MAZDA Sunlight Lamp (Type S-1) is also available in new fixtures and for renewal purposes.

Question—Can a sunlamp fixture be plugged into any outlet?

Answer—Yes, provided the current is 60 cycle, alternating. But both the MAZDA Sunlight Lamp (Type S-1) and the MAZDA Sunlight Lamp (Type S-2) must always be used in fixtures made expressly for their use.

Below are shown some of the special fixtures required for the use of the new MAZDA Sunlight Lamp (Type S-2)



BEARDSLEE CHANDELIER
MANUFACTURING CO.,
216 South Jefferson St., Chicago, Illinois
BENJAMIN ELECTRIC MFG. CO.,
Des Plaines, Illinois
BRADY MANUFACTURING COMPANY
565 East Larned St., Detroit, Mich.
CURTIS LIGHTING, INCORPORATED,
1123 West Jackson Blvd., Chicago, Illinois
DOMINION ELECTRICAL MFG. CO.,
712 Ontario Avenue, W., Minneapolis, Minn.
THE FRINK CORPORATION,
23-10 Bridge Plaza South, L. I. C., N. Y.
GENERAL ELECTRIC COMPANY,
Merchandise Department, Bridgeport, Conn.
THE EDWIN F. GUTH COMPANY,
Jefferson & Washington Aves., St. Louis, Mo.
HEALTHMASTER SUN RAY LAMP
DIVISION, LIBERTY ELECTRIC CO.,
50 West North Street, Indianapolis, Ind.

HOLOPHANE COMPANY, INC.,
342 Madison Avenue, New York, N. Y.
THE KAYLINE COMPANY,
600 Huron Road, Cleveland, Ohio
LIGHTOLIER COMPANY,
569-575 Broadway, New York, N. Y.
LUMINATOR, INC.,
851 Washington Blvd., Chicago, Ill.
THE MILLER COMPANY, Meriden, Conn.
MOE-BRIDGES COMPANY,
220 North Broadway, Milwaukee, Wis.
S. ROBERT SCHWARTZ & BRO.,
160 Varick Street, New York, N. Y.
THE F. W. WAKEFIELD BRASS CO.,
Vermilion, Ohio
WESTINGHOUSE ELECTRIC
AND MANUFACTURING CO.,
Edgewater Park, Cleveland, Ohio



MAIL COUPON FOR FREE BOOKLET

"Ultra-Violet for Everyone" describes the MAZDA Sunlight Lamps (Type S-1 and Type S-2) and illustrates some of the new inexpensive fixtures now available.

You may obtain this booklet by mailing the coupon to Ultra-Violet, 2145 Keith Building, Cleveland, Ohio. Any manufacturer listed here will gladly send you detailed information regarding the fixtures made by him.

ULTRA-VIOLET, 2145 Keith Bldg., Cleveland, Ohio
Kindly send me, without charge, a copy of
"Ultra-Violet for Everyone."

Name.....
Street and Number.....
City..... State.....

black. Darken the hoofs and the muzzles.

HARNESS. Rings: Wind wire tightly around rods of proper size, round or rectangular, and cut off with a jeweler's saw, lengthwise of the form.

Collar: Saw the blocks with a bevel, groove for the hames, and shape. Glue and pin the pieces to the horses, inserting the wear leathers, and fill the joints with wood plastic composition or gesso.

Hames: Cut lengths of bale wire—or better, heavy brass wire—and taper both ends. The lower ends of the hames are pointed, while the upper ends are left blunt to receive beads for balls. Bend hooks on the lower ends. The tug rings are separated from the hames by loops of flattened wire, while the line rings are soldered direct.

Kidney Links: Bend these to shape. Engage them with the hames and press the latter tightly into the collar grooves. Hold the upper ends together with wire until the straps are placed.

Trace Buckles: These are double, the vertical members being narrower than the others and lying behind them. Press the pairs together with pliers to flatten their crossings.

Back Pad: Coat the underside with glue to stiffen it. Press it into shape to fit the horse's back, with the center brought up to a point to clear the spine. For triangle rings, use pins. Glue the strap to the pad.

Tug: The strap has a buckle in an end loop, and is passed through a hame ring. The other end, widened where it lies behind the buckle, has a vertical slit through which the trace is threaded before entering the buckle.

Trace: Note the cockeye, three chain links, and hook. When buckled, glue the long loop around it and the tug.

Bellyband: Put a buckle at each end to engage with a strap looped in each tug buckle.

Bridle: Attach the noseband. Represent the bit with two pins cut short and bent into hooks to clasp the ring. Push the points into the head. The back strap loops through the bit ring and is buckled so that the winker will be centered lengthwise on the eye. Hollow the mane behind the ears and the forelock to receive the crown and front pieces. Use dress spangles or cardboard painted with aluminum for the front-piece bosses. The face brace lies under the front piece, with the winker brace above it.

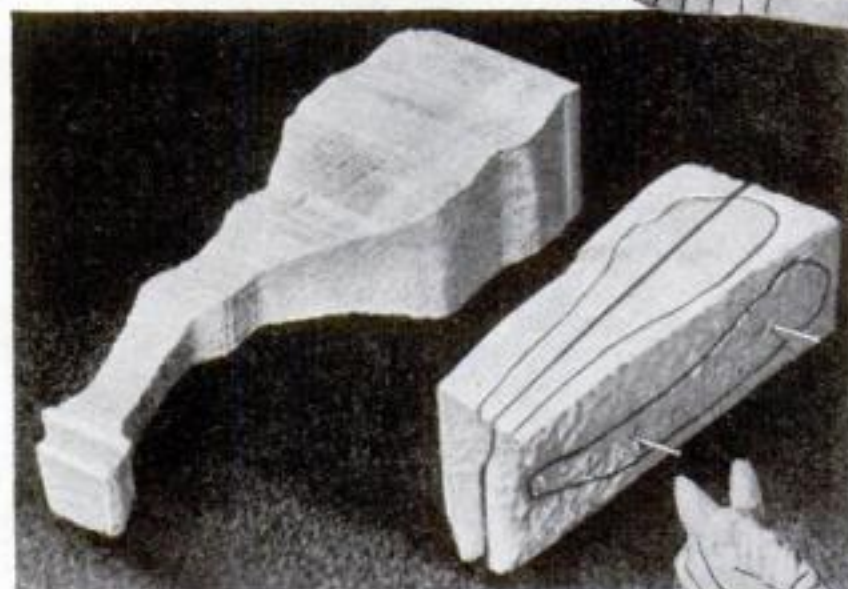
Lines: These buckle through the bit rings. The coupling reins buckle to the draft reins from the inside, crossing each other after passing through the hame rings, and buckling to the inner bit ring of the other horse.

Mounting: Hitch the horses to the coach, arranging them on the base, and mark the hoof positions. Drill 3/16-in. holes at the centers of the hoof outlines. Drill holes in the horses' legs small enough so that the mounting wires bind, and fasten with cement. Thread the ends through the base holes, bend them over beneath, and fill the holes with wood composition. Screw rubber feet to the base.

To help you carve the horses, this model was painted white and striped on one side with a series of lines



The view above shows the model as it appears when one is looking directly down on it. This supplements the drawings given on Blueprint 146

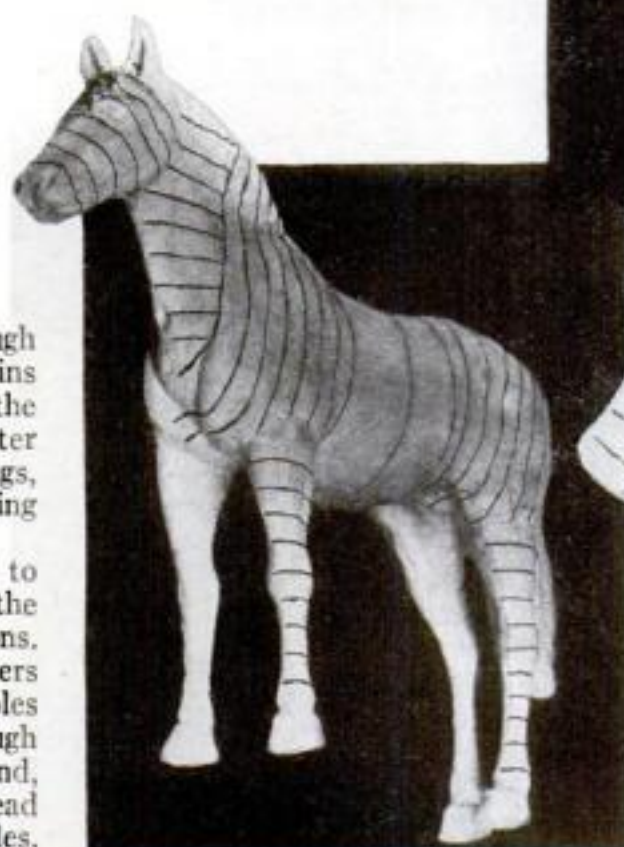
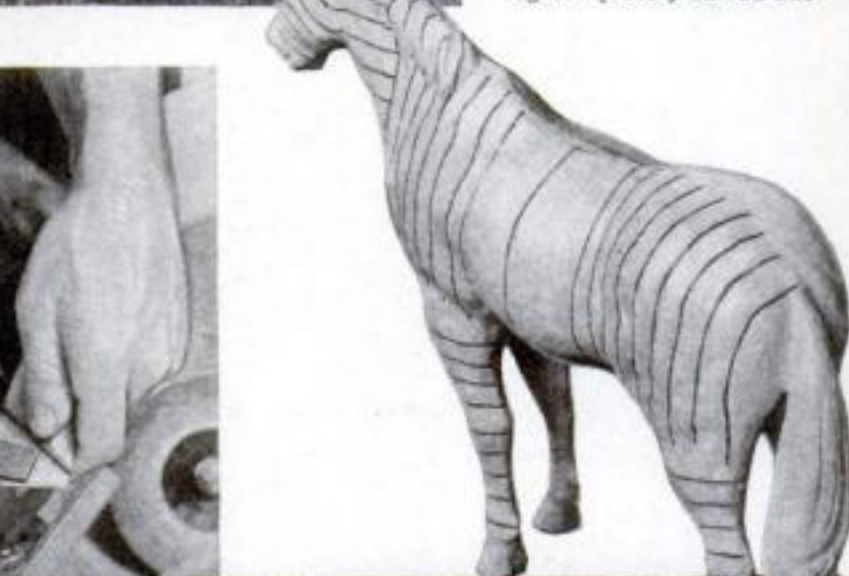


The general method used for roughing out all the blocks is indicated at the left. The tail is shown jig-sawed from one side and with the waste pieces pinned in place ready to be sawed from the other side. Alongside the tail is a hind leg completely sawed out



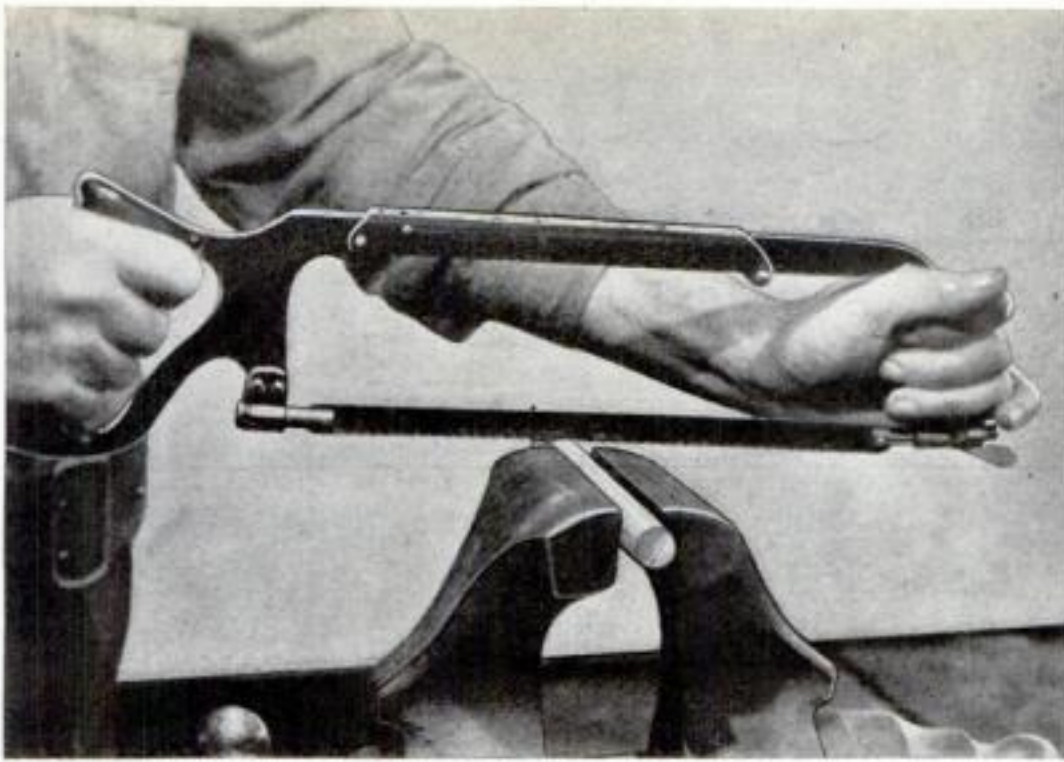
The hame stock is tapered in the lathe by supporting it on a hardwood block and filing it at high speed

Each group of parallel lines on the horse illustrated is intended to bring out the modeling of the muscles so that it will be easier to do the carving



For variety, make the head of one horse a little higher than the other and alter the position of the feet a trifle to give a more lifelike effect

When the carving is finished, the horses are smoothed with sandpaper, ready for painting



Pages 23-28

Show You the

Easier ways to cut metals in home shops

HOME workers who like to make things of metal, will find an intensely interesting section devoted to the latest methods of metal-cutting, in this new how-to-do-it book.

Pages 23 to 28 were written by a well-known authority on shop metal work, and they show you how to do all kinds of metal-sawing, faster, easier and better.

First, he tells how to get the best results with hand hack saws, how to select suitable blades for various metals, and how to hold and cut pipes, rods, tubes, band or angle iron, thin metals, etc.

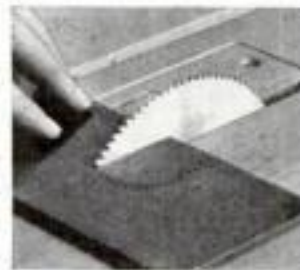
Next, he takes up metal-cutting with circular saws and shows how speedily and accurately many metals may be cut on a saw table; also, how to cut hard compositions with special circular saws.

Then comes a page on how to saw out sheet metal projects with a metal-cutting band saw blade, in a fraction of the time taken by hand methods. Next, he tells about Bakelite Bonded Wheels, used as circular saws, to cut hard and soft steels, cast iron, slate, tile and similar materials difficult to saw in any other way. There are helpful hints on grinding metals, and making handy guides for saw tables.

But this is only one of nine sections in the book. Whether your hobby is working with wood or metal, for pleasure or profit, you'll find a wealth of practical instruction in these chapters on . . . owning a home shop . . . planning a new shop . . . selecting shop tools . . . choosing woods . . . making 24 joints . . . building shop fixtures . . . cutting metals . . . obtaining 450 job plans . . . and so on.

The final chapter gives you helpful facts on the world-famous "Silver Steel" saws and shows you the best type for each job of cutting wood or metal. If your hardware dealer does not have the Atkins Saws you want, write us. This 40-page how-to-do-it book will save your time, improve your work, and increase the fun or profit from your workshop. Send only 10 cents for a copy today. Use the coupon below.

Hard composition panel, 4x1/4", cut in 20 seconds by this Atkins type "L" Silver Steel circular saw.



8" Brass hinge strap cut out in 2 minutes with an Atkins Silver Steel metal-cutting band saw.



Tough tile is cut rapidly with this Bakelite Bonded Wheel, used on circular saw table in home shop.



ATKINS SILVER STEEL SAWS

E. C. ATKINS AND COMPANY (Est. 1857)
428 S. Illinois Street, Indianapolis, Ind.

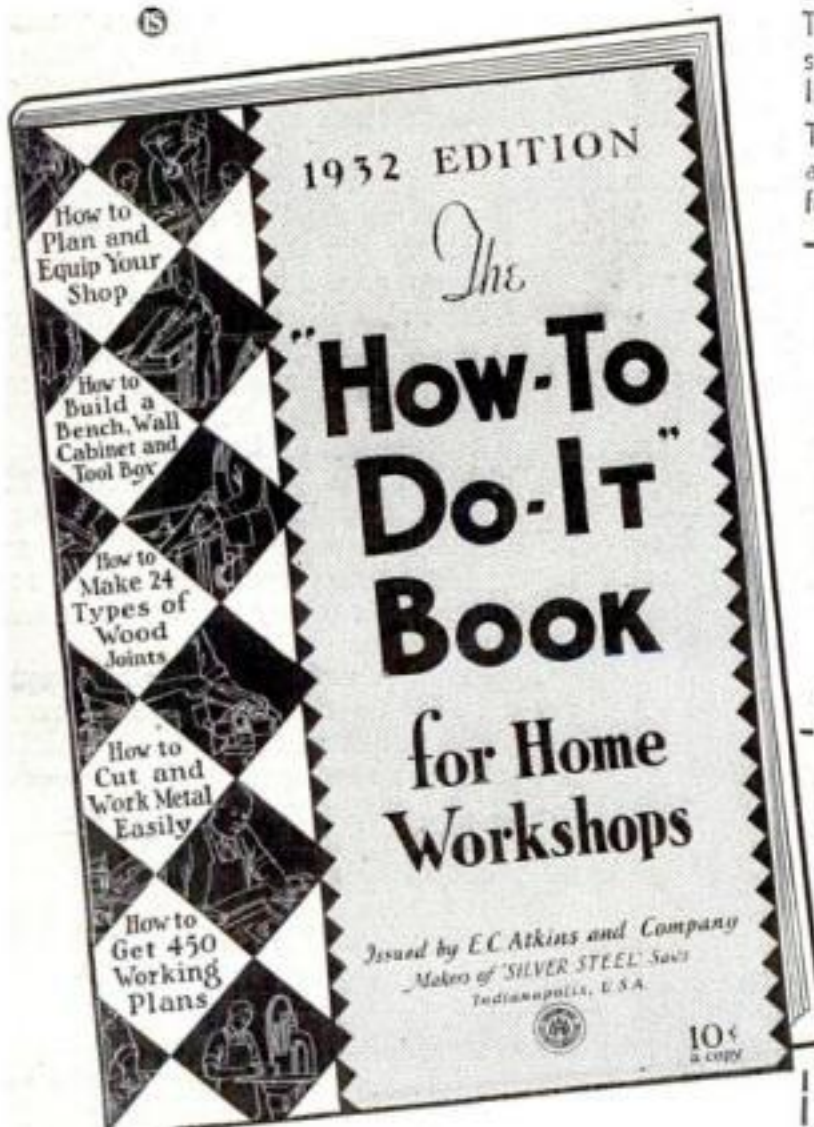
I enclose 10c for the ATKINS Home Workshop Book, 1932 Edition.

Name.....

Street.....

City..... State.....

My dealer is.....



How to Banish Chatter Marks

... THE BUGABOO OF GRINDING

By HECTOR J. CHAMBERLAND

Toolmaker and Grinding Expert

CHATTER marks are the greatest enemy to external cylindrical grinding. They are always a source of trouble to the operator whose knowledge is not well beyond the experimental stage.

Machine parts and tools are cylindrically ground to correct imperfections resulting from either a turned finish or the heat treatment, and also to obtain the correct size and fit. With present-day machine construction, a satisfactory surface is especially important because a large percentage of ground work is given a lapped finish, and this is where chatter marks offer a problem to work out.

It is evident that a lapped surface can be only as good as the operation that preceded it; therefore it is often a fact that parts which have been lapped appear worse than they did before.

There are two kinds of chatter marks. Some are easily visible at the average working distance; others are the so-called "invisible" marks that make their appearance only after lapping. The trained operator is such a close observer that he will detect either type in time and make the necessary corrections. It is, therefore, to the semiexperienced mechanic that the following suggestions are offered.

These imperfections, generally speak-

ing, result from either vibration or errors in speed. They are chiefly encountered in the small or job shop, where the old style belt-driven machines are generally used; but it is not to be assumed that something of the sort will not happen with equipment of a late type. While the grinding machines of today, with gear drives and individual motors for wheel and work, reduce to a large extent the chances of inferior work, it is obvious, nevertheless, that a machine which has been used for any length of time without any overhauling will bear more careful watching than a new one.

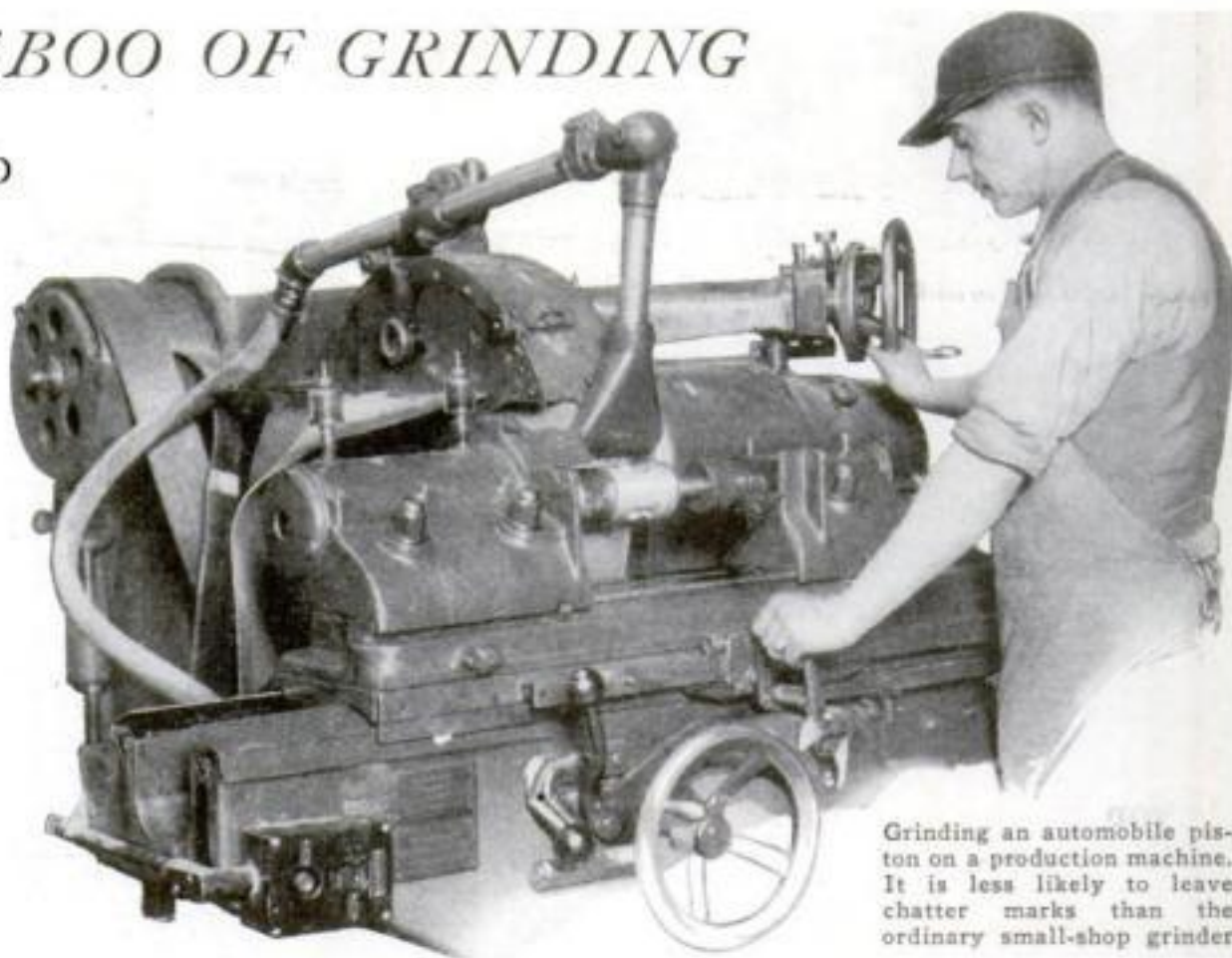
A grinding lesson of the utmost importance that the average operator is likely to overlook is the proper relation between wheel speed and work

speed, plus a correctly graded wheel suitable for the work being ground. Each individual speed, whether wheel, longitudinal, or work, must be uniformly maintained during the operation, regardless of the make, condition, or driving mechanism of the machine.

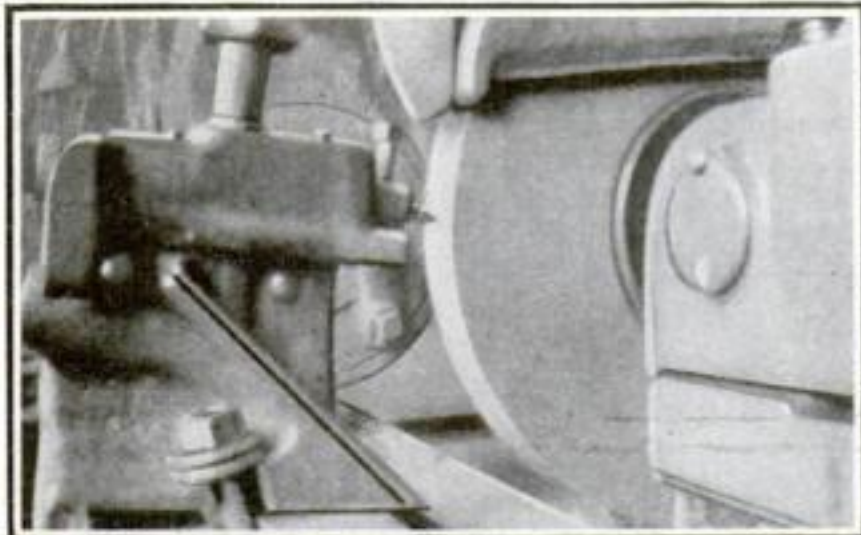
If the grinding wheel is operating at its required surface speed and is of the proper grade and grain, the first thing to check up, when chatter marks appear, is the work speed. The operator should use his own common sense to decide whether a medium weight or a heavy piece is revolving so fast as to cause vibration. At the same time, he should see that the driving pin is not loose or too weak. It is also important that the work speed and the longitudinal or traverse feed be proportional; if not, the work will have a corkscrew appearance.

All belts should be clean and dry, have good driving power, but not be too tight. They should be scraped occasionally and coated with a good belt dressing. The pump belt, if neglected, will interfere with the flow of the grinding solution and cause much trouble. The wheel and work belts should be uniform in thickness and cemented; uneven spots or lumps running over either pulley will cause troublesome vibration.

A perfect job of this kind also depends a good deal on the conditions governing the performance of the grinding wheel as a whole. The bearings should be inspected often; and all play, including end play, should be eliminated. If the wheel is the least out of balance, the entire machine will vibrate. The larger the wheel, the more vibration there will be; besides, constant danger lies in the path of the operator if such conditions exist. Wheels properly set in their individual mounts are safer and more satisfactory. The out-of-balance error is, as a rule, common when a wheel is mounted on the spindle

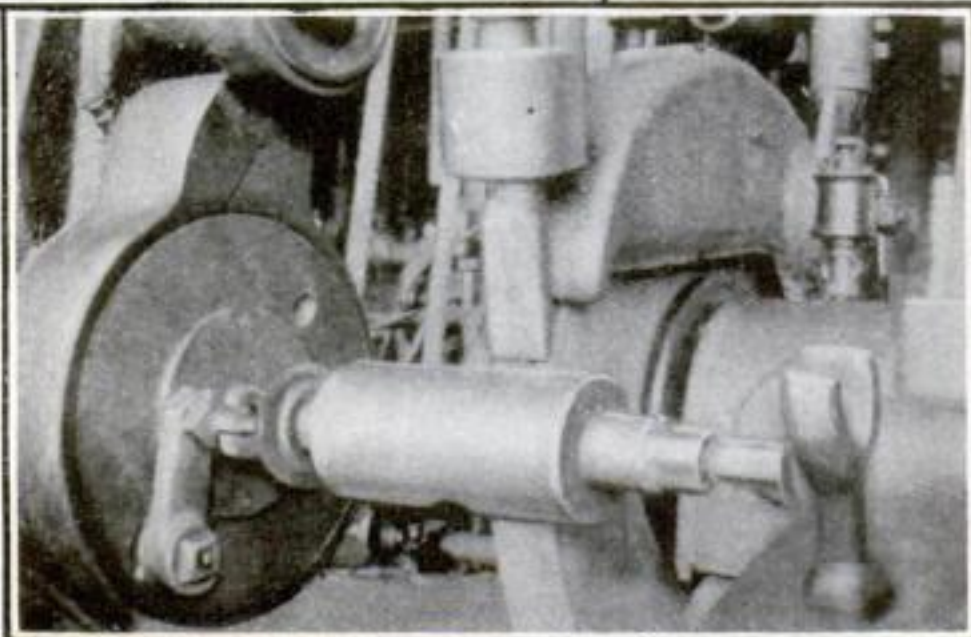


Grinding an automobile piston on a production machine. It is less likely to leave chatter marks than the ordinary small-shop grinder



Dressing a wheel at a point about midway between the centers will give better results when grinding long work than if the diamond is clamped to the tailstock

At the right is shown a filter for the grinding compound. By removing all grit, it goes a long way toward preventing what are called "invisible chatter marks"



USE STARRETT HACKSAWS

NO ARGUMENT

Expert tool users have ideas of their own on everything else under the sun. But they don't waste any words about tools. There's no question about it—no more argument than there is about a diameter after you put a Starrett mike on it. Good machinists like Starrett Tools—and the best like them most.

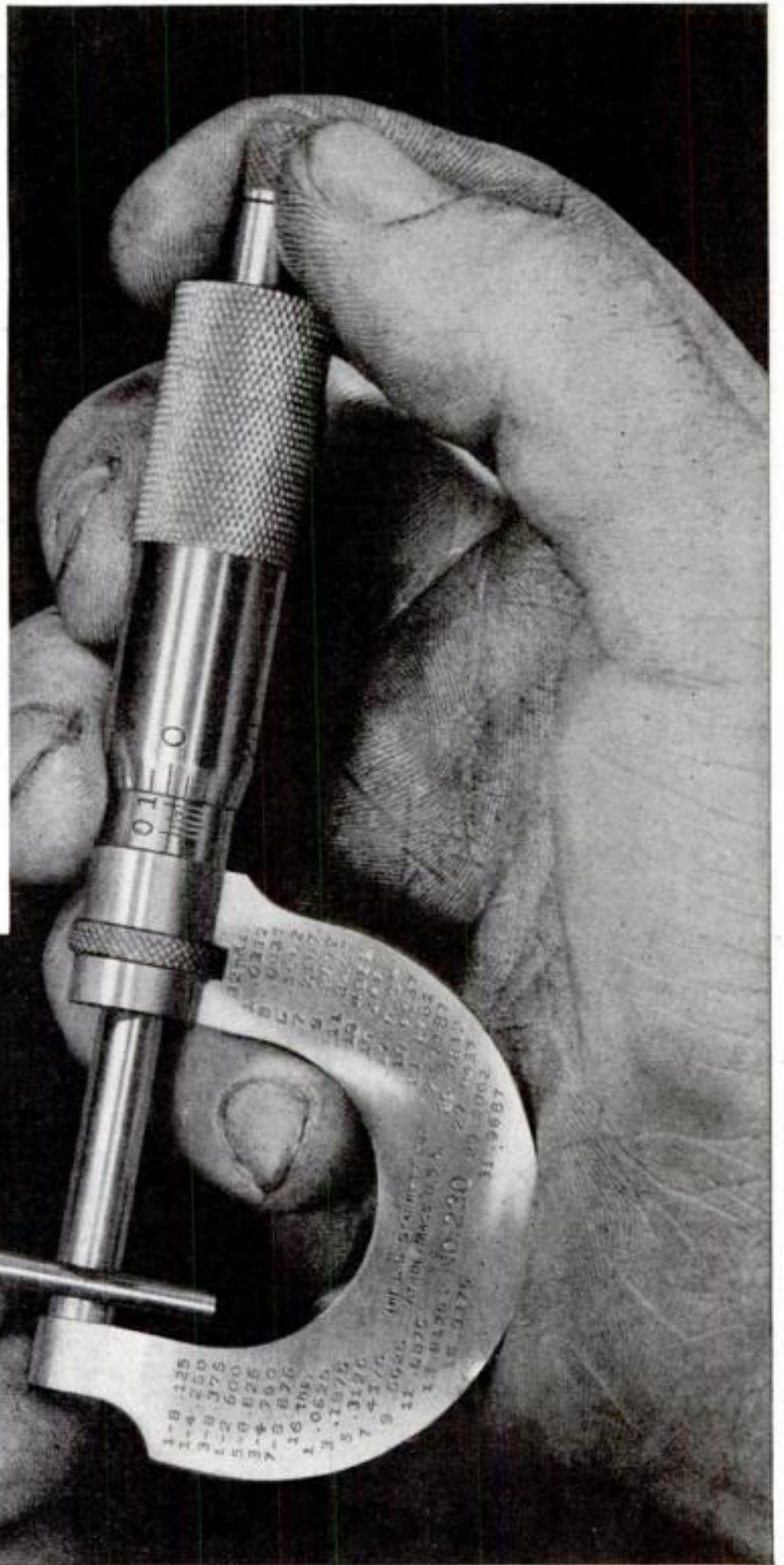
For their accuracy, of course. But more than that—their design, which means easy, rapid work—their workmanship which keeps them on the job for years beyond the life of ordinary tools—their dependability.

Standardize on Starretts for your kit and your work will be better—faster.

Write for a copy of the Starrett Catalog and check it over for the tools you need. Ask for No. 25 W.

THE L. S. STARRETT CO.

World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
Steel Tapes—Standard for Accuracy
ATHOL, MASS., U. S. A.



Use Starrett Tools

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proper. When changing wheels, the operator should throw on the speed slowly and note the action of the wheel face.

Even when the grinding wheel is properly balanced and everything combined with the wheel-head is in good shape, it often happens that the wheel acts as if it were out of round, in spite of having been freshly dressed. In this case, the condition of the diamond should be investigated. The diamond may be either loose in its setting or so blunt that it has no real cutting effect and will not bring out the thousands of sharp edges or abrasive "teeth" that actually do the work. When the diamond performs with a strain rather than freely, it leaves the wheel more or less imperfect or out of round. Furthermore, if the grain is not properly open, the wheel will glaze over rapidly and cause skips in the grinding, and the results are again chatter marks. A grinding wheel and a good diamond are like a pair of gloves—one has little value without the other.

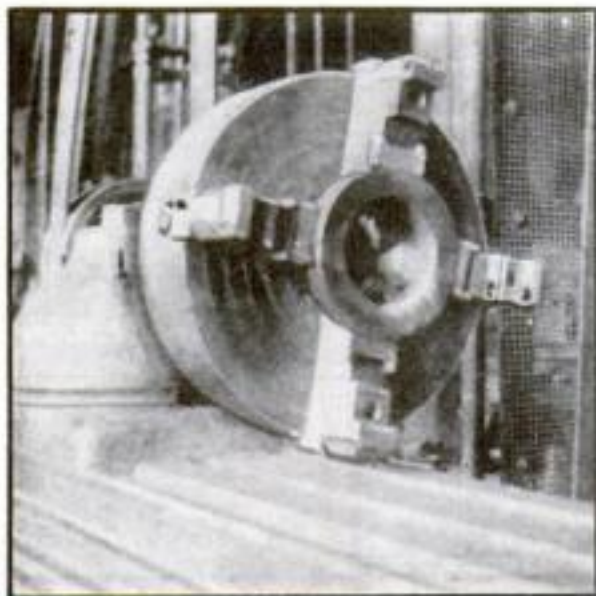
Imperfections often appear while grinding long work. They are generally traced to the following sources: The shoes may be loose in the holders of the steady rests. The work may not be running true enough to get a satisfactory bearing. The length of the work may be such as to require the wheel to be dressed at a location out of average working range.

A location for the steady rest shoes should be first spotted on the work by feeding the wheel very slowly to attain perfectly round bearings, and allowing the sparks to die out. Proper adjustments should be made to the tension according to the diameter of the work. As to the number of rests required, it is better to have one extra than to lack one.

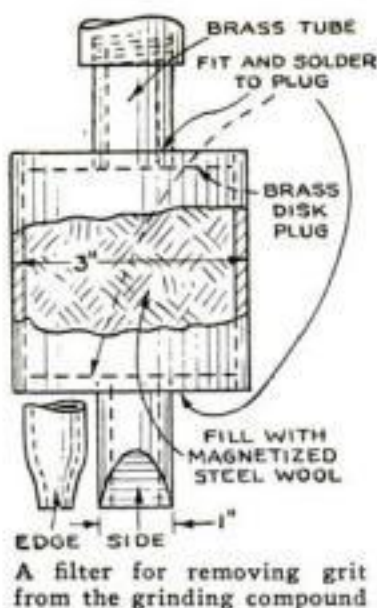
If a long shaft is turned only on the ends for bearings and the center left in the rough for some reason or other, it will vibrate because of being out of balance, and the finish will be like a washboard—

STEP BLOCKS FOR LATHE AND GRINDER CHUCKS

THE step blocks illustrated below will be found an improvement over the regular loose style for holding sleeves, bushings, and collars in lathe and grinder chucks. They are made a press fit for the jaws and may be retained in place simply by closing in the ends. They are excellent timesavers.—L. N. D.



These step blocks are made a press fit for the jaws of the chuck and will not fall off

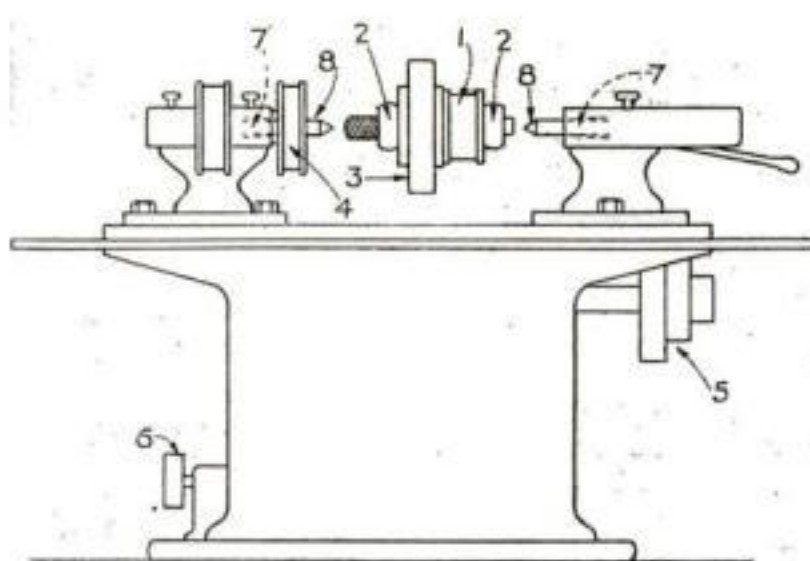


A filter for removing grit from the grinding compound

a condition much worse than chatter marks. It is more economical to turn the shaft for its entire length before grinding.

Where the diamond is attached to the tailstock, considerable trouble is again experienced in grinding long work, regardless of the construction of the machine; that is, whether the wheel traverses the work or the work traverses the wheel. The reason for this is clear. Very little wear is apparent at the extreme end of the ways, so when the wheel is dressed at that location, it will not cut on its entire face as the grinding proceeds from one end of the shaft to the other. Instead, the wheel will cut from one corner or the other.

The writer has remedied this trouble by making it a rule to dress the wheel at a point about central to the work, as illustrated in one of the photographs. In



COMMON CAUSES OF CHATTER MARKS

1. Loose wheel belt. 2. Worn bearings. 3. Wheel out of balance. 4. Loose work belt. 5. Loose longitudinal feed belt. 6. Loose centrifugal pump belt. 7. Improperly fitted centers in head- and tailstock. 8. Angle of center points not the same as that of work centers. Check all of these points

this case a discarded steady rest was used to hold the diamond.

It is well to bear in mind, in addition, that an occasional check-up of the wheel slide will do no harm.

Chatter marks also result under the following conditions: If the centers are not properly fitted to the head or tailstock; if the center points are not mated to the work centers, or the centers worn from want of lubrication; when the grinding compound has been used for some time so that particles of grit accompany the flow and cause marks which are not, as a rule, visible to the naked eye. When a high finish is desired, the straining device illustrated in the lower photograph on page 94 and in one of the drawings on this page, will give excellent results if used with fresh compound.

The grinding operator will find it good practice to use a magnifying glass if a lapped finish is to follow.

We Pay for Ingenious SHOP IDEAS

WHENEVER you work out some way of doing a job a little quicker or easier than usual, remember that you may be able to turn the idea into cash by sending it to POPULAR SCIENCE MONTHLY, especially if you are able to illustrate it with a good photograph. A bulletin is now ready telling you how to recognize saleable ideas and how to prepare articles about them for this department. You can obtain it by sending a stamped, self-addressed envelope.

ROLLER STAND SUPPORTS HEAVY STEEL STOCK

A GENERAL utility stand for supporting heavy materials in a steel shop is made of 3 by 3 in. angles assembled as shown at the right in the shape of two A's and well braced with smaller angles or straps. All braces are kept several inches from the top, and three or more slanting notches are cut in the edge of the angles to receive the spindles of the roller. To adjust for machines of different heights, the roller is simply lifted from one notch to another.—J. C.



This off-bearing roller stand is designed to support heavy steel stock as it comes from various machines. The notches in the frame allow the roller to be adjusted to suit the height of the machine with which it is used

You'll get amazing results repairing and modeling with this PLASTIC WOOD



Handles just like putty . . . quickly hardens into wood

Science has perfected an amazing preparation that handles like soft putty and quickly hardens into wood—wood that lasts longer than natural wood—wood you can carve, paint and turn in a lathe. Wood that never dries out, never rots nor warps after it hardens. It is the best thing you can use for repairing breaks, hiding nicks, sealing cracks. It does an expert job in a jiffy. BUT BEWARE. There's only one original. So avoid accepting imitations. If you want the very best at no additional cost—DEMAND PLASTIC WOOD. It is sold in 9 colors by all paint, hardware and department stores.

Marvelous for modeling

Thousands of folks who never before worked

**DEMAND THE GENUINE
PLASTIC WOOD
comes in 9 colors**

with their hands are discovering what skilled artisans have known for a long time. With



Plastic Wood they are making a thousand and one useful things—from fanciful woodpeckers and proud galleons to book-ends and mirror frames. Many are now

making extra money this way. If you want some fun—try your hand at modeling with Plastic Wood. You'll get a thrill!

BIG 48-PAGE BOOK FREE

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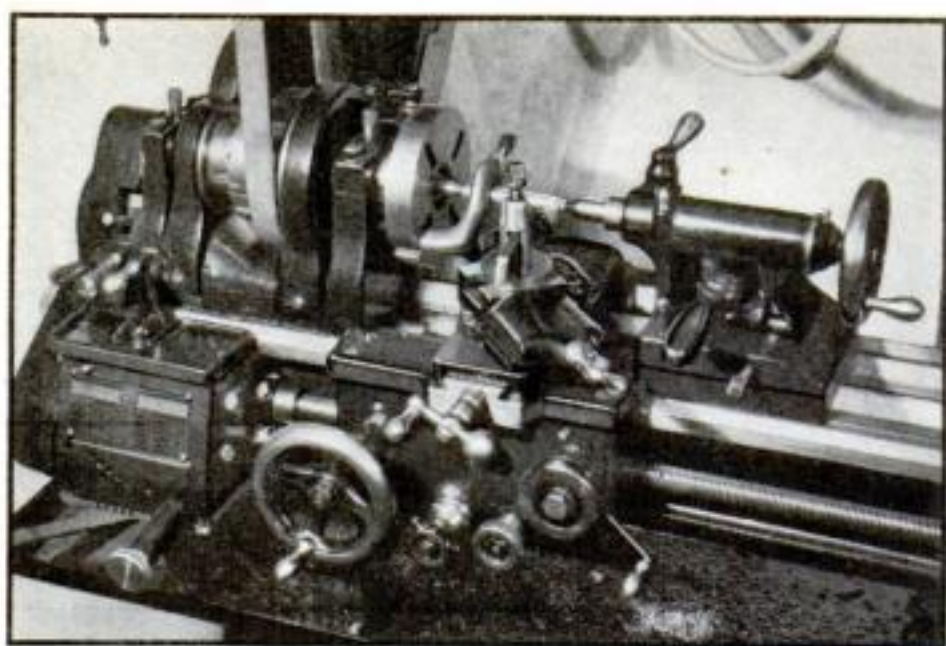
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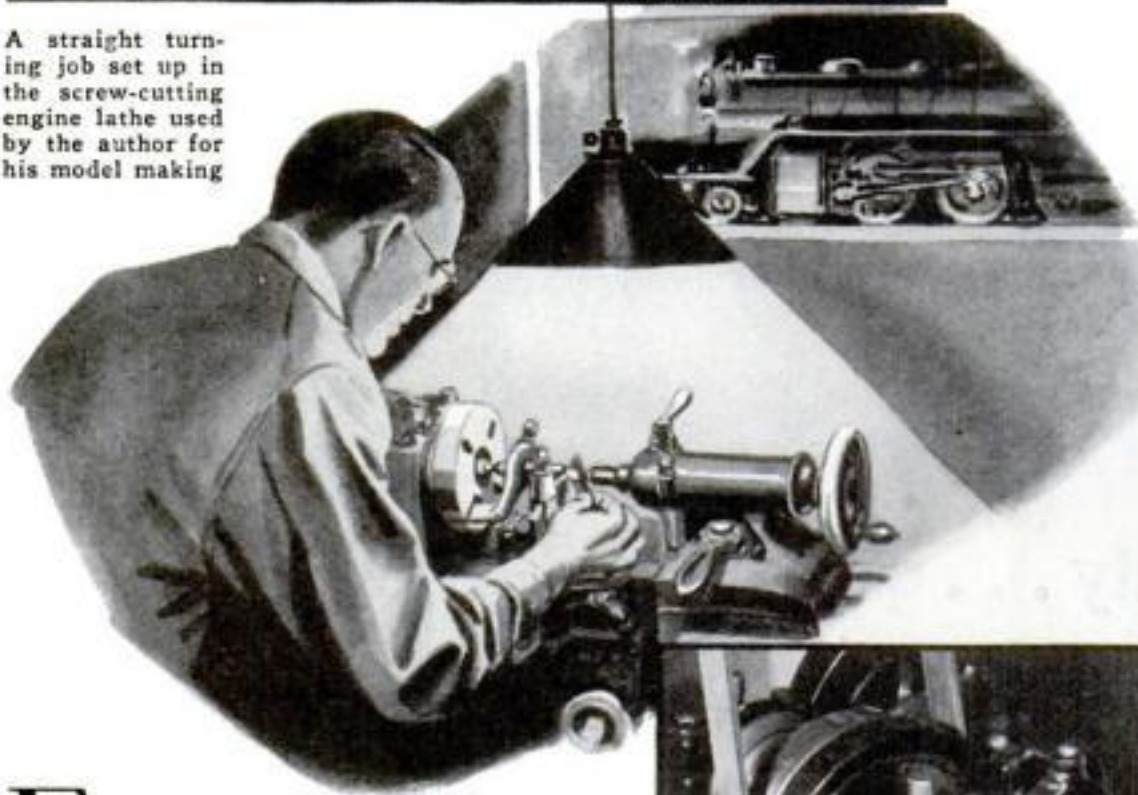
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THIS OFFER GOOD IN UNITED STATES ONLY



A straight turning job set up in the screw-cutting engine lathe used by the author for his model making



EVERY model railway enthusiast has wondered, at one time or another, how he could get a metal turning lathe. In the case of those of us who could scrape together the necessary cash, these longings have resulted in the purchase of what has been aptly described as the granddaddy of all machine tools. The rest of us have had to be content with make-shifts pending the happy day when we, too, possess a real lathe.

I do not mean to infer that you cannot build a model railway unless you have a lathe. Such lathe turned parts as you need can be bought ready-made, but there is a lot more satisfaction and considerable economy in doing the job yourself, as any model maker will understand.

The metal turning lathe is the most important of all machine tools because, by the aid of suitable attachments, it can be made to do an almost unbelievable variety of work. While its principal function is to produce all sorts of perfectly cylindrical forms from iron, brass, aluminum, copper, and so on, as well as to bore round, straight holes, it also will turn true threads externally or internally if it has the necessary thread cutting equipment. A milling attachment converts the lathe into a milling machine capable of doing a vast amount of grooving, slotting, and recessing which would otherwise have to be done by extremely difficult hand filing and chiseling. In short, the lathe really is a milling machine, a power drill, a thread cutting machine, and a

Above: An eccentric boring set-up with the work held in an independent four-jaw chuck, which is especially valuable for gripping small parts of irregular shape

metal turning outfit rolled into one.

Although all model railway enthusiasts who build any of their own rolling stock have need for a metal turning lathe, those who have had no experience with such an outfit usually are a bit hazy as to their own requirements.

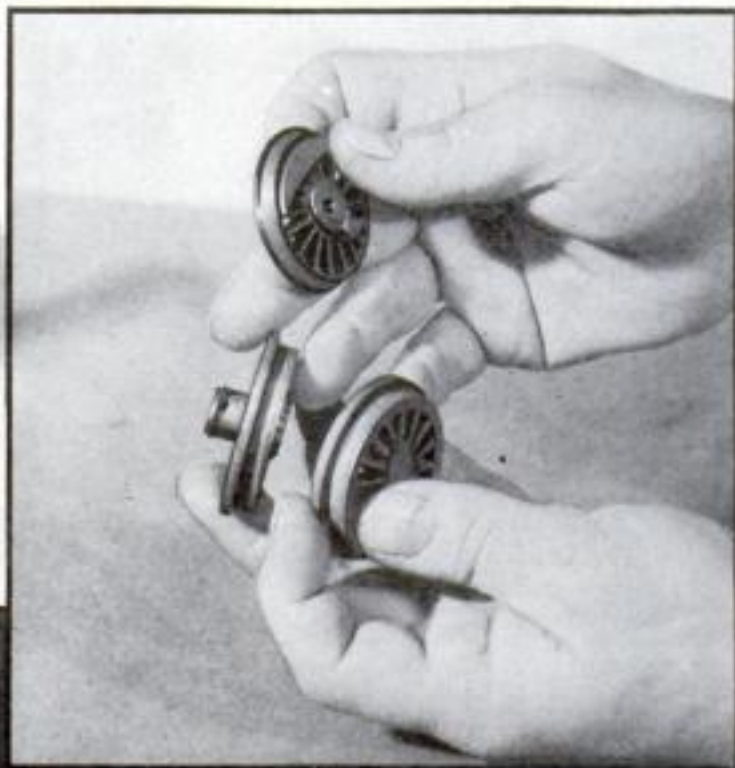
The simplest possible metal turning lathe consists of an accurately cut metal bed or slideway at one end of which is

The LATHE

Most Important of All Machine Tools to the Builder of

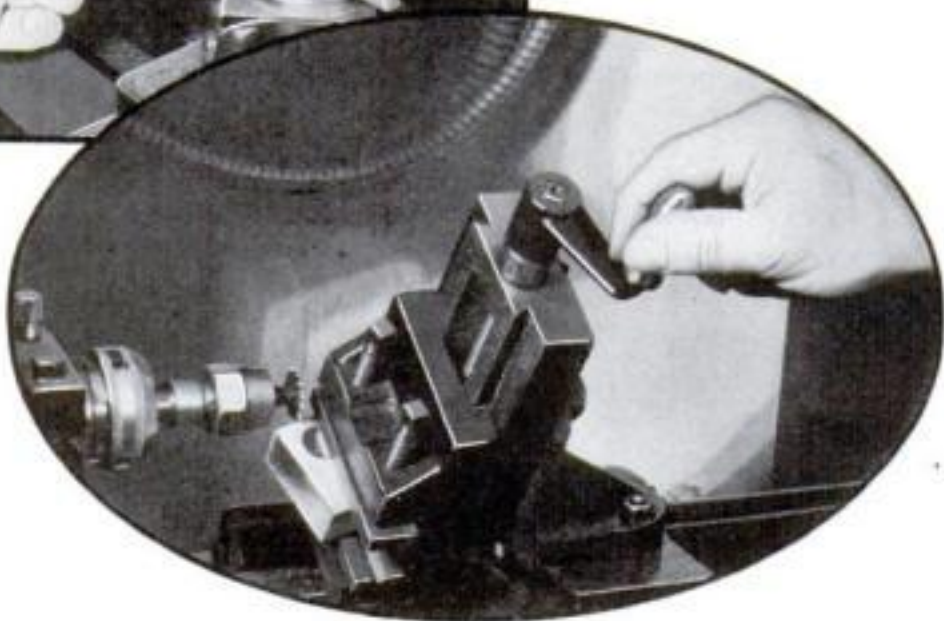
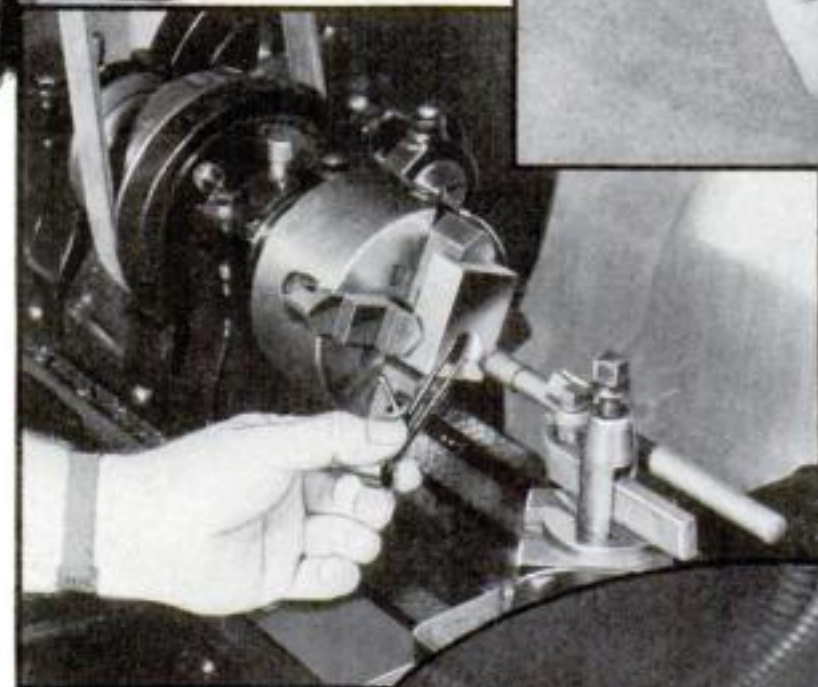
Model Railways

By THOMAS W. ARNOLD



The rough castings for a pair of "O" gauge locomotive wheels and, above, the same kind of wheel when it has been turned in a lathe. This is one of many jobs which need a lathe

In the oval below is shown a milling attachment used with the author's lathe. It is of great help to the model maker who is constructing a locomotive to be operated by steam



rigidly fastened a headstock. This is nothing but a hollow shaft riding in two bearings with a pulley mounted on it between the bearings. The end of the shaft facing the opposite end of the bed is threaded on the outside and bored to an accurate taper inside. *(Continued on page 116)*

Good Work Requires Good Tools

Genuine Irwin Bits are the perfect wood boring tools. (They are made only by Irwin)



A PERFECT BIT should have strength to avoid bending or breaking. Should have proper clearance for easy flow of chips. Should be straight and true and most of all should have a cutting head so constructed that it will bore a smooth, accurate hole. Genuine Irwin Bits have all these things. They are forged from a solid bar of steel. They are not twisted from a mold. This gives the great strength required and better chip clearance.

They are machine straightened in patented machines.

The head formed by automatic machines, not by hand, insures close tolerance and that accurate co-ordination between the pitch of the cutters and the pitch of the screw thread which makes for smooth, accurate boring.

Instructors of manual training and fine cabinet makers use Genuine Irwin Bits. Why shouldn't you? Look for the trademark on the shank of the bit.

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How Deep?

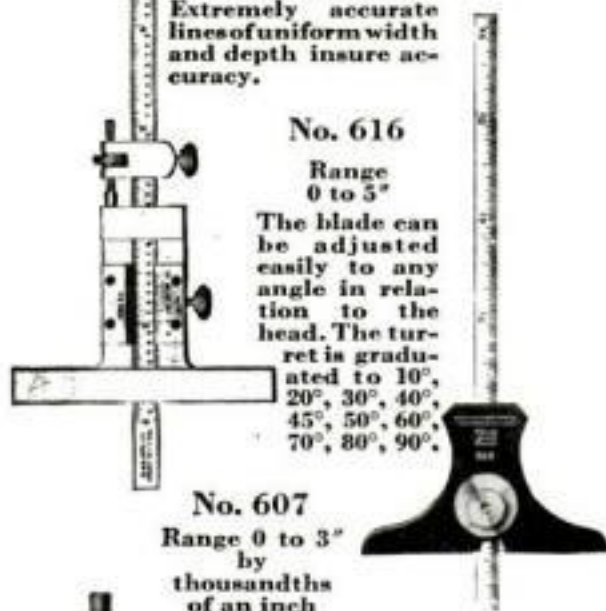
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Five typical styles are shown here

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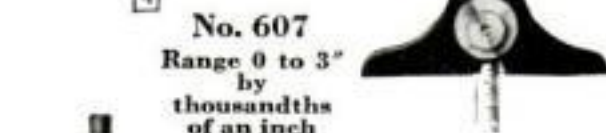
Two sizes: 6 inch blade and 6 and 12 inch blades. Measures, by means of a Vernier, in thousandths of an inch. Extremely accurate lines of uniform width and depth insure accuracy.



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Range 0 to 5"

The blade can be adjusted easily to any angle in relation to the head. The turret is graduated to 10°, 20°, 30°, 40°, 45°, 50°, 60°, 70°, 80°, 90°.



No. 607

Range 0 to 3" by thousandths of an inch

An accurate Micrometer Depth Gauge. Has three rods for measuring depths up to 3". Furnished with 2½" or 4" base.



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Range 0 to 5"

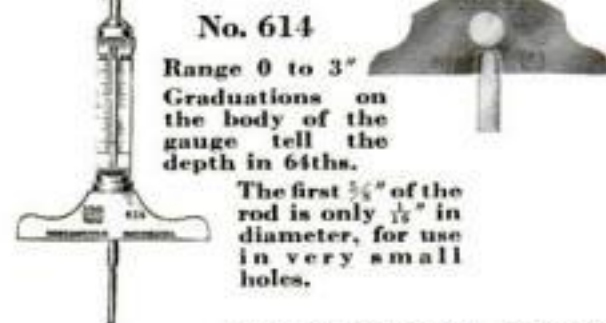
A combination Drill Point Gauge and Depth Gauge. Can be used, also, for checking angles of drill points.



No. 614

Range 0 to 3" Graduations on the body of the gauge tell the depth in 64ths.

The first ⅝" of the rod is only ⅛" in diameter, for use in very small holes.



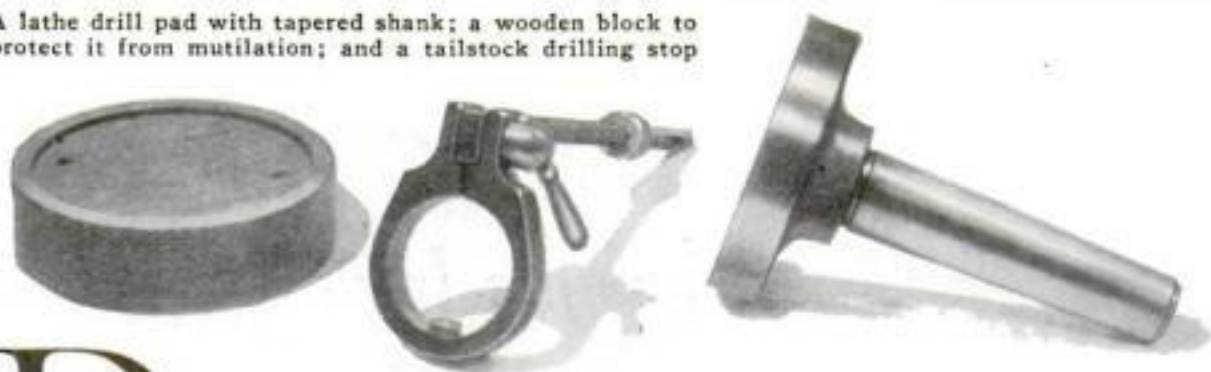
Our Small Tool Catalog No. 31 describes these and other Depth Gauges as well as over 2300 other Brown & Sharpe Tools. Ask your dealer for a copy or write to us for one. Dept. P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.



Brown & Sharpe Tools

"World's Standard of Accuracy"

A lathe drill pad with tapered shank; a wooden block to protect it from mutilation; and a tailstock drilling stop



Drilling Accessories

that will make your lathe more useful

By HOLT
CONDON

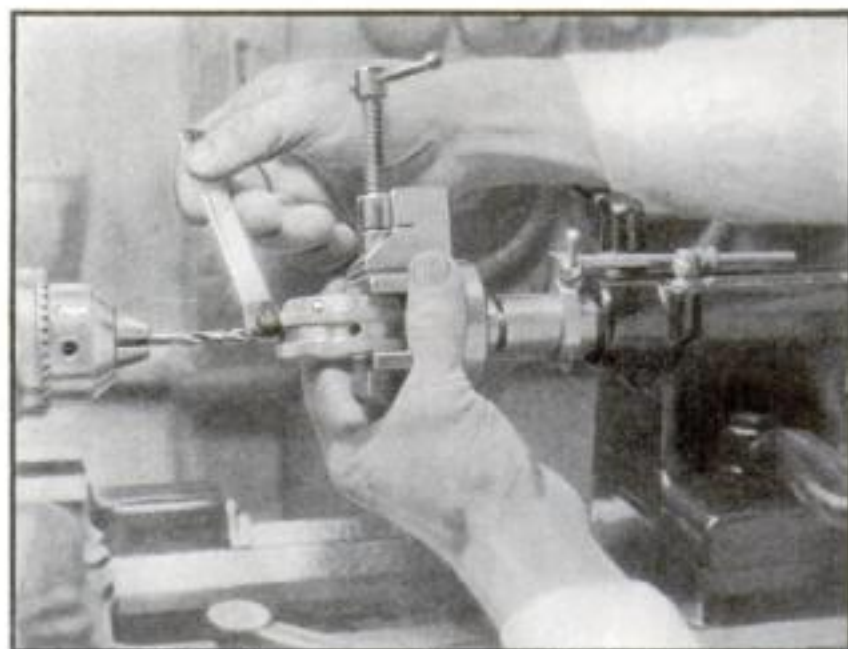
WITH the idea of equipping his 9-in. lathe for as many machining operations as possible, the writer has made the simple and useful drilling accessories illustrated—a drill pad and a tailstock stop.

The making of a drill pad presents a nice problem in taper turning for the amateur machinist. The one shown was machined from a solid piece of cold-rolled steel, although it could well have been made in two pieces with a taper press-fit joint. This would have involved more work but saved material.

To discuss calculations for setting over the lathe tailstock to yield certain tapers would take too much space to go into here; indeed, the problem in this case was merely to reproduce on the shank of the work a taper which corresponds to the lathe centers. Measurements were taken with scale and micrometer, and the tailstock was adjusted until the two tapers compared closely. The turning was done on centers, making it possible to dismount the work readily for the final fitting. This fitting was accomplished by drawing pencil lines along the shank and worming it into the tail-spindle bore. By returning it to centers and filing it a very little, it was found to fit so closely, when again tested in the tail-spindle bore, that the pencil lines were wiped out throughout their whole length—proof of a perfect fit.

The flange was drilled and countersunk for screws so that the pad could be used as a handy driver for turning patterns or other wooden parts. The hardwood disk illustrated at the left in the upper photograph has a recess in the back to allow it to be pushed over the drill pad as a protection against mutilation in drilling.

The tailstock stop was designed to help in producing holes or counterbores of predetermined or duplicate depth. A graduated spindle would largely discount the value of this tool, but the writer's lathe



Drilling in the lathe with the aid of a drill pad and tailstock stop, the work being held in a small commercial vise

was not so equipped; and this attachment, comparable to a drill press or turret lathe stop, goes a bit further.

The yoke, which hugs the tailstock, allows the spindle to slide freely through it until clamped, when it moves forward with the feed to whatever limit has been fixed by the thumb nut on its threaded arm. This movement may be set and read directly on a scale screwed to the tailstock casting with its zero at the final stud through which the beam slides. There is a key at the bottom of the bore in the yoke which fits in the keyway in the spindle and so holds the device from turning. The yoke was made from a piece of flat stock and bored and faced in the lathe chuck. The profile was worked out at the bench.

The little vise shown in use against the drill pad may be purchased. With its removable V-block jaw (not shown), it makes a fine work vise; and, being machined on all sides, it aids in laying out and setting up work.

This is the fourth in a series of articles on the home machine shop (see P.S.M., Nov. '31, p. 115; Dec. '31, p. 106; and Feb. '32, p. 108). The author is a machinist and toolmaker of exceptional experience and has a well-equipped home workshop in which many of the accessories, such as those described above, have been made on his 9-in. engine lathe. He is preparing other articles on the same general subject.

HANDY MILK BOTTLE BOX FITS CELLAR WINDOW

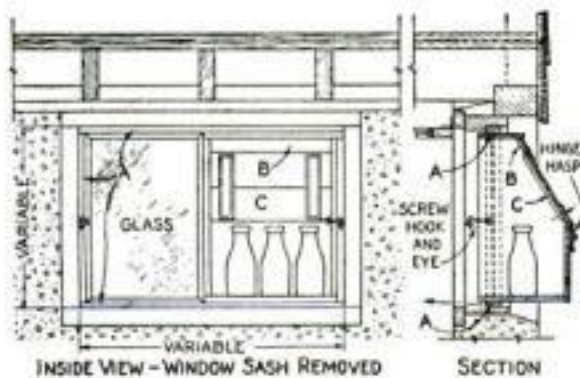


This window box is open at the back so that the milk bottles can be removed from inside

WITH a window box like that illustrated, it is not necessary to go outside or even to open a door in order to bring in the milk bottles during the cold and stormy months. The box is built to fit the most accessible basement window.

First a frame is made of 1 by 2 in. dressed lumber set edgewise as indicated at A below to fit snugly in the rabbet or groove in the window frame where the screen is placed in summer. The sides of the box are then made of $\frac{7}{8}$ in. thick wood to avoid warping. It is important to have the box deep enough so that the milk bottles can be set into it easily by the milkman. The top should project far enough to clear the window frame, and directly under it is placed a strip of wood B to which the cover C may be hinged. The cover should overlap the front to keep out snow and rain.

That part of the frame not filled by the box should be closed with glass. The frame is held in place with two hooks and eyes. To gain access to the box from the inside, it is necessary merely to lift up the regular sash, or the sash may be left hooked up all the time. In summer the box may be taken out, and the regular screen set in place.—W. F. REUTER.



How the box is made and set in a frame, the remaining part of which is filled with glass

Whaling Ship Ahoy!

IN A NEW series of articles beginning in the April issue, Capt. E. Armitage McCann tells how to make a model of the famous old whaling ship *Wanderer*.

1

It drills holes

2

countersinks

3

drives in the screws

Now is the time to buy the good tools you need. Here is one of today's great tool values. Ask dealer to show you this ingenious "Yankee" Tool and its Attachments.

WITH a window box like that illustrated, it is not necessary to go outside or even to open a door in order to bring in the milk bottles during the cold and stormy months. The box is built to fit the most accessible basement window.

First a frame is made of 1 by 2 in. dressed lumber set edgewise as indicated at A below to fit snugly in the rabbet or groove in the window frame where the screen is placed in summer. The sides of the box are then made of $\frac{7}{8}$ in. thick wood to avoid warping. It is important to have the box deep enough so that the milk bottles can be set into it easily by the milkman. The top should project far enough to clear the window frame, and directly under it is placed a strip of wood B to which the cover C may be hinged. The cover should overlap the front to keep out snow and rain.

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IT drills holes, countersinks holes for screwheads, and drives in the screws—simply by pushing on handle. In same way, it runs up small nuts. And all at express speed! Or it does all these jobs by ratchet movement.

With the *spiral* movement, the drill or bit is revolved by a spiral in the tool, when handle is pressed down.

With *ratchet* movement, you turn drill or bit by moving the hand forward and back without releasing your grip on handle.

No. 30-A.—Standard Spiral Ratchet Screw-driver. Price, including three bits, \$3.00.

No. 130-A.—Quick-Return Spiral Ratchet Screw-driver with spring in handle, \$3.45.

Also Heavy and Light patterns.

1

Chromium Plating over nickel on "Yankee" Tools now adds lustre and lasting finish, at no increase in price.

2

"Yankee" Attachment for countersinking holes for screwheads. Sold separately.

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"Yankee" Tested Bits, three sizes for different size screws. Included with each screw-driver.

"YANKEE" TOOLS

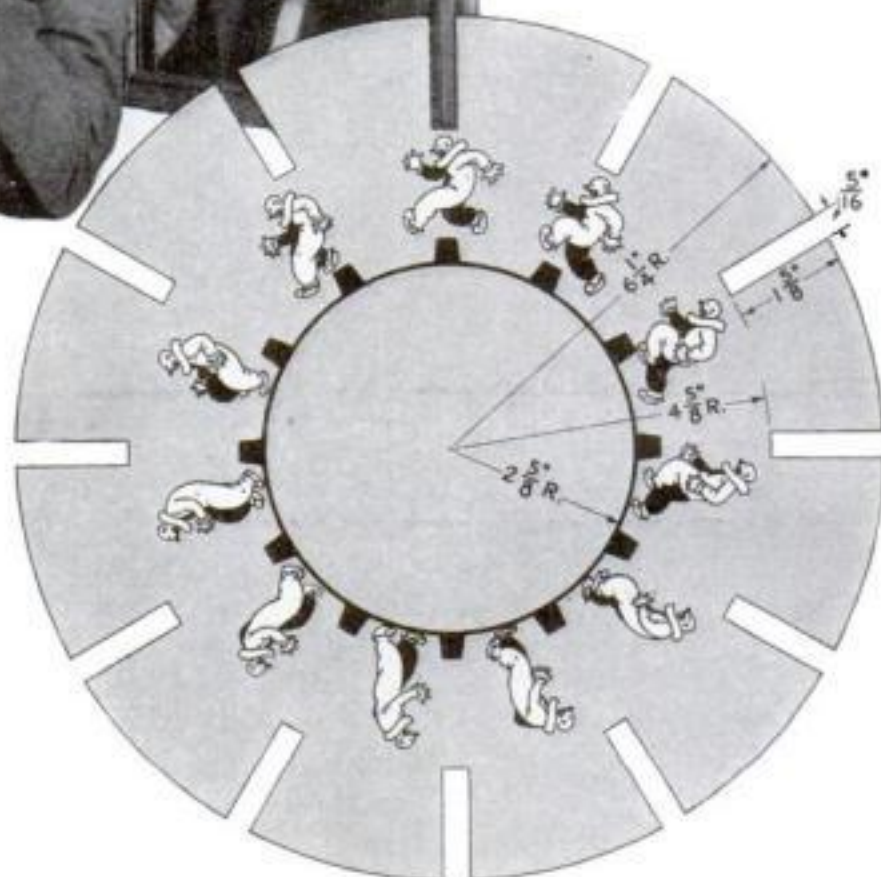
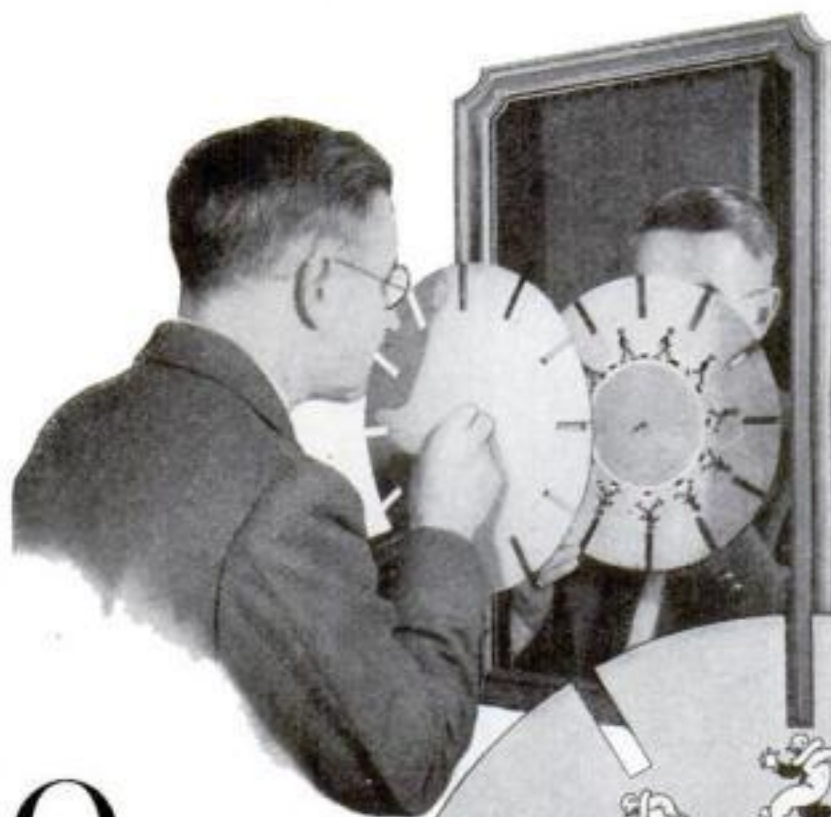
TO HELP YOU MAKE THINGS

Get new "Yankee" Tool Book filled with action pictures showing the ingenuity in use of many "Yankee" Tools with the famous "Yankee" Ratchet. Mail coupon to NORTH BROS. MFG. CO., PHILADELPHIA, U. S. A.

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You can make your own ANIMATED PICTURES

*Amusing
Little Figures
Drawn on
Whirling Disk
Appear
to Move
with Lifelike
Realism*



Two disks, one in use and the other drawn so that you can enlarge it easily. Each has twelve slots but only eleven figures

ONLY a sheet of cardboard, a sharp knife, and a little skill in drawing are required to make the amusing animated picture toy illustrated above. It is operated by holding the disk on a pin or wire spindle in front of a mirror and peering through the slotted edge at the reflection of the clowns in the glass.

On spinning the disk, the clowns will begin chasing each other around the ring in a series of realistic jumps and keep it up merrily until the disk stops turning. The principle used by this device is the same as that of the modern motion picture, though in a much simpler form. The slots take the place of the shutter in the motion picture machine; and instead of projecting the images through a film on to a screen, they are viewed directly in a mirror.

To make it, take a piece of stiff, flat card, and, following the dimensions shown in the drawing, swing circles with a compass for the outside edge, the base of the slots, and the ground line. Then divide the disk into twelve equal parts for the slots. The easiest way to do this is to draw a small circle $\frac{5}{16}$ in. in diameter (the width of the slots) at the center and, using a 30-60 degree triangle, project six pairs of parallel lines at 30, 60, 90, 120, 150, and 180 degrees from the circumference of the $\frac{5}{16}$ -in. circle.

After cutting the slots with a sharp knife, draw the twelve buckets on the ground circle as shown. Then draw the clowns, of which it will be seen there are

only eleven. If there were twelve, no movement except up and down would be possible. With eleven, each clown moves forward one jump at each revolution of the disk. To get the best effect, paint the figures with strong, bright colors in simple form.

A small piece of wood about $\frac{1}{4}$ in. thick, drilled to take the spindle and glued at the center of the card, will keep the disk running true and parallel to the mirror. The disk will be easier to hold and operate if the spindle, which may be a pin, a needle, or a piece of wire, is set in a convenient wooden handle.

A striking demonstration of the lifelike way in which the figures move can be made in a few minutes by preparing a cardboard disk exactly the size of the drawing above. Small as it is, such a disk will show the principle upon which these animated pictures work. Then a full size disk can be cut out and, if desired, other figures than the jumping clowns may be sketched in experimentally.—S.O.

Dill's
SINCE 1848
Best

The more you
like a pipe the
more likely you
are to say

Dill's Best
is America's Best

YOUR NEXT CAR— NEW OR USED?

(Continued from page 74)

minute ago," Fosket reminded him, "that the most economical buy is a one-year-old second-hand car. How do you figure that out?"

"That's easy, if you're figuring only on cost per mile without taking style, looks, or anything else into consideration. The market value of a car—that is, the price at which you can buy it—is about forty percent less by the end of the first year. Yet that car will have at least seventy or eighty percent of its useful mileage still in it.

"Suppose you take a car that costs a thousand dollars and assume it's good for fifty thousand miles. If you drive that car for the full distance, your depreciation is going to cost you two cents a mile less whatever you can get for the car from the junkie. Now if you buy a one-year-old car that has been driven, say, ten thousand miles, and you pay six hundred for it, and you drive it till the speedometer shows fifty thousand miles, it's only going to cost you a cent and a half a mile for depreciation, and that figure is also cut by what you get at the auto graveyard."

"BUT that saving won't make enough of a hit with the wife to offset the fact that she'll be driving in an older car," Fosket grumbled.

"I didn't say it will," Gus grinned. "All I'm giving you is the facts. It's up to you and your wife to decide how those facts fit your case."

"Maybe I could get around that trouble by going in for a higher priced second-hand car. It would have more useful miles in it and that would cut the cost."

"It used to be that way," Gus explained, "but not any more. Fifty or sixty thousand miles marks the end of the economical life of any car today no matter what its price. The only difference between a low priced car and a more expensive one now is that the more you pay the more car you get in size, looks, and riding qualities."

"Anyhow you've cleared up some points that were a bit hazy," Fosket admitted. "Now, can you tell me just how much difference there is in the cost of operating a big car as compared with a little one?"

"It all depends on how many miles you drive a year," said Gus.

"ASSUMING you drive five thousand miles a year, your cost per mile will be about five to seven cents for a light four or six, a trifle over nine cents for a medium six or a light eight, and around eighteen cents for a big, heavy eight."

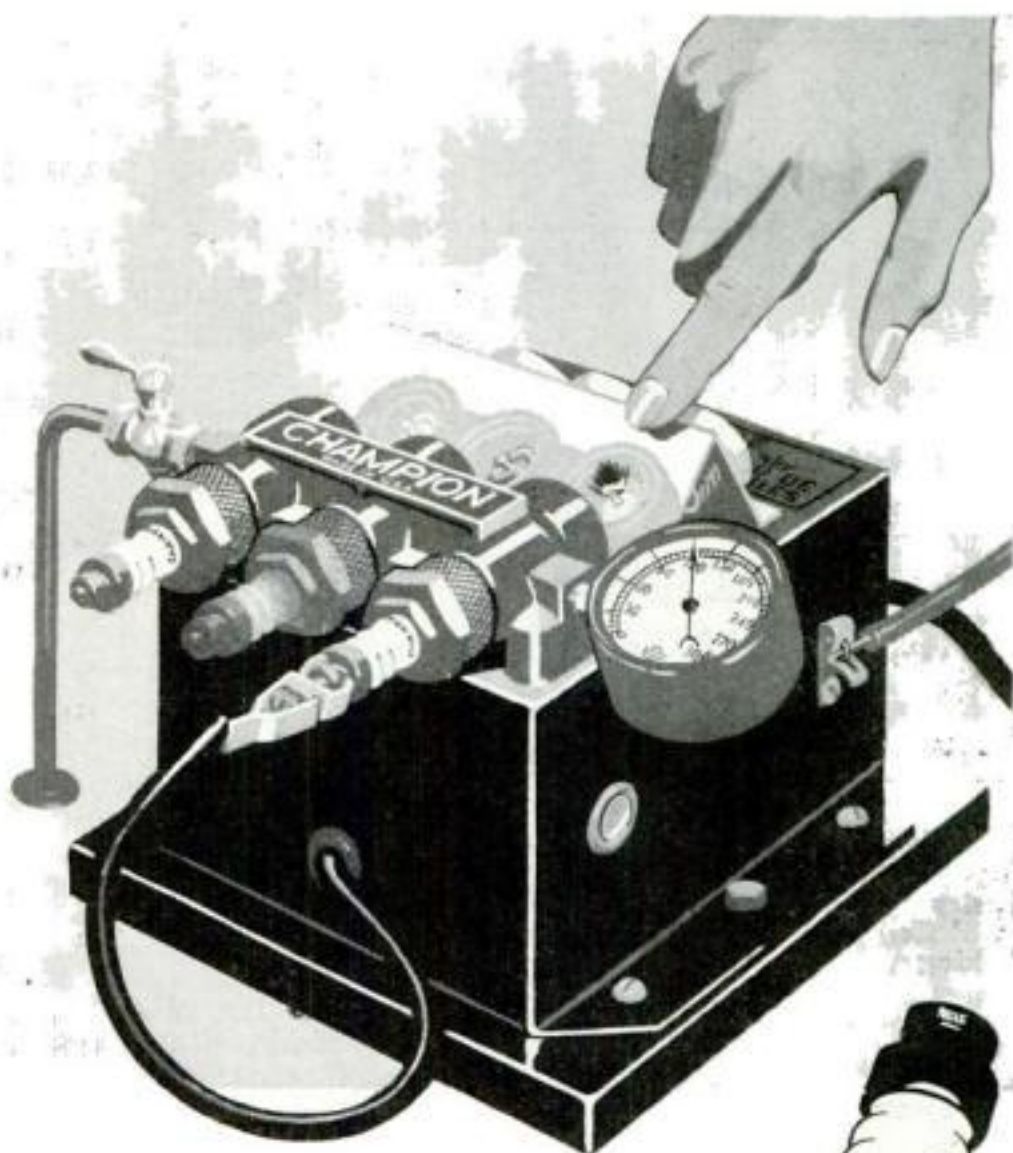
"All right. Now tell me how to be sure of getting a good secondhand car, if the decision goes that way," requested Fosket.

"The only sure way I know of," Gus suggested, "is to buy a car only when you know its complete history—how many miles it's been driven and who owned it."

"Of course," Gus went on, "most times you can't get all that dope, but you can at least make sure that you're buying the car from an established sales agency for some well-known make of car."

CHANGE SPARK PLUGS EVERY 10,000 MILES FOR BETTER ENGINE PERFORMANCE

CHAMPION TESTER SHOWS WHY AND WHEN YOU NEED NEW SPARK PLUGS



TO PROPERLY serve motorists who want to know why and when they need to change spark plugs, the Champion Spark Plug Tester is now in the hands of dealers everywhere.

You plainly see under compression similar to the operating conditions in your own engine, the weak, wavering and wasteful spark of your old spark plugs. Then you see, and compare to this the clean, full and intense spark of new Champions—the spark that brings renewed efficiency to every engine.

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Motorists who regularly install new Champion Spark Plugs every 10,000 miles have learned from experience that they renew engine power, speed, acceleration and economy each time.

Champion Spark Plugs are preferred by the majority of the world's motorists. Their better performance is demonstrated by consistent and unparalleled victories in the major racing events of the world.

CHAMPION SPARK PLUG COMPANY, TOLEDO, OHIO; WINDSOR, ONTARIO

CHAMPION SPARK PLUGS

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with

"PINEDALE PACKAGED LUMBER"—DIRECT from the mill TO YOU

Even the beginner will find this unusual paper basket remarkably easy to construct, and every home craftsman will find it worth while because its striking design makes it a truly distinctive piece of furniture. And now that you can get your lumber direct from the mill, you'll find it easier than ever to make this—and other projects, too.

Send today for our booklet describing 12 new furniture projects—select the ones you'd like to make—and order the corresponding "Pinedale" packages. Simple, isn't it? The wood is California Sugar Pine (Genuine white pine)—and it comes to you ready-to-use, square-cut, dimensioned, surfaced on both sides to assure a minimum of waste—and at the low prices that only one of the world's largest mills can offer. You'll find this lumber just about the easiest you ever worked with—light and soft, yet strong and durable. Easy on screws and nails, perfect for all kinds of paints and stains.

Here, for the first time, is a definite and convenient source of lumber supplies. Each "Pinedale" package contains enough lumber, conveniently and economically sized, for its corresponding project—and also, complete easy-to-read working plans for making it. We can supply California Sugar Pine for any and every purpose. Just tell us what your requirements are, and we'll let you know what the lumber will cost, parcel-post prepaid. Whatever you make, you can be sure that this wood will be entirely uniform in quality and texture, straight in grain, and thoroughly dry.

Mail Coupon for Booklet and New Jig-Saw Puzzle

Send for it today. You'll be happy when you see how easy and sure we've made home furniture building—and you'll have loads of fun with this new jig-saw puzzle made out of a sample of California Sugar Pine.



SUGAR PINE
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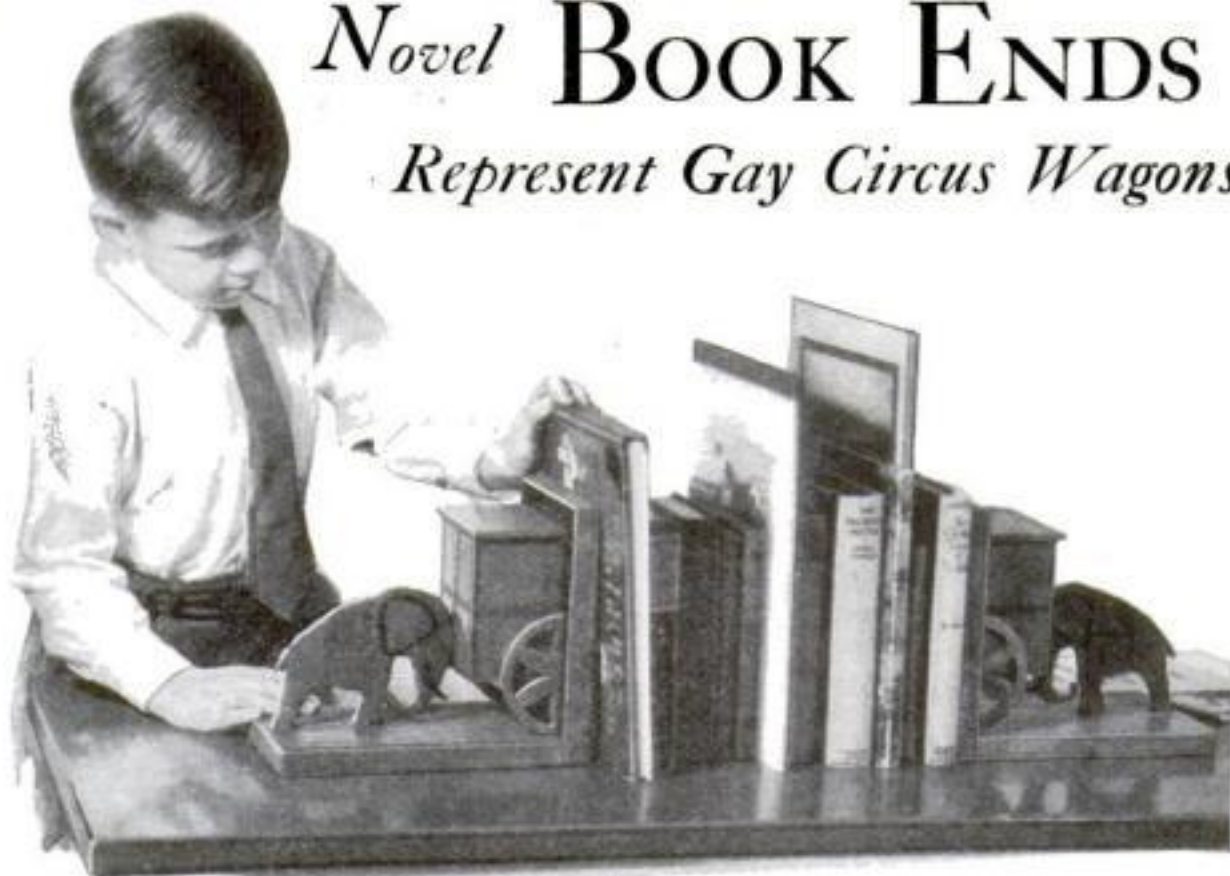
P. S. 3-32

I am enclosing 10c to cover the cost of sending me your new handbook of "Things to Make With California Sugar Pine." Also send me the jig-saw puzzle.

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Novel BOOK ENDS *Represent Gay Circus Wagons*



Any small boy will gladly keep his books in order if he has book ends like these, each with its own secret compartment

TWO realistic elephants, pushing brilliantly colored circus wagons, support the books placed between these unique book ends which were designed for use in a child's room. As an added feature, the top of each circus wagon can be lifted to reveal a secret storage space for prized possessions.

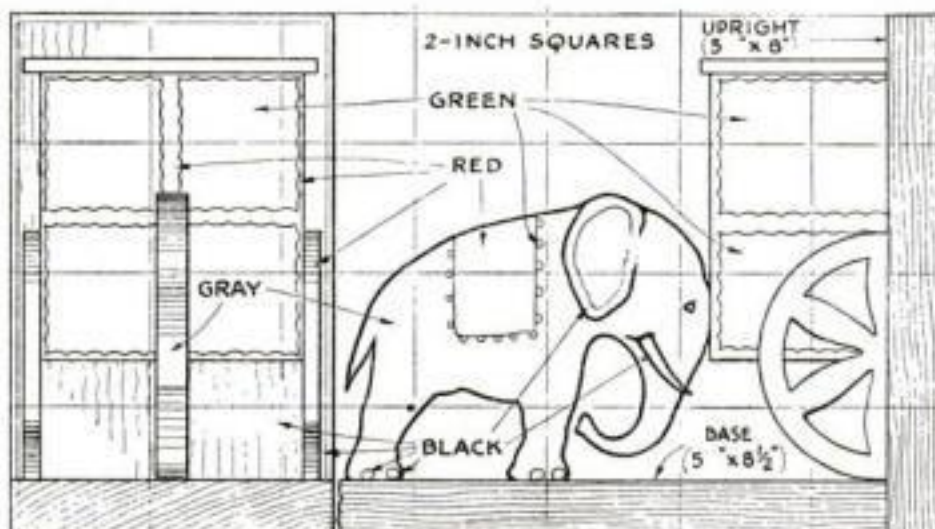
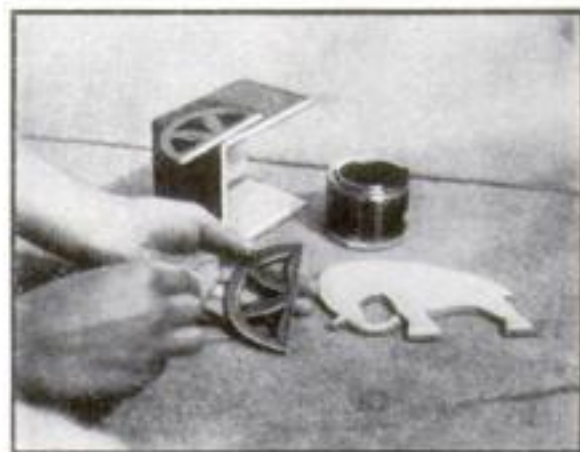
The design was submitted by Chester Peterson, of Hancock, Mich., and won a prize in the POPULAR SCIENCE MONTHLY contest for novel ideas in home workshop projects (P.S.M., Apr. '31, p. 87). The model illustrated was made from the prize winning design by Charles H. Alder.

In fashioning these novel book supports, cut the base pieces and uprights first and assemble with glue and nails. The circus wagons, which are of 1/4-in. stock, can be made by assembling one complete box and cutting it in half. A like procedure is followed in constructing the wheels—two complete wheels furnishing the four half-wheels required. Each of the removable tops can be made most easily from two pieces of 1/4-in. stock, nailed and glued together, one piece large enough to project slightly over the edges of the box and the other small enough to fit inside and keep the top from sliding off.

Plywood at least 1/4 in. thick and pref-

erably 1/2 in. thick is suggested as stock for the elephants, which are fastened in place with brads and glue.

Much of the charm of these book ends lies in their brilliant coloring. First, finish the uprights in their natural color or with stain as preferred. The outer face of the upright pieces, against which the wagons fit, should be painted black except for a narrow margin around the edges. The black represents the doorway into which the circus wagon is being pushed. The wagons should be painted as indicated in the drawings. The elephants, of course, should be colored gray with red and gold or green harness. The ears, tusks, and eyes are outlined in black.

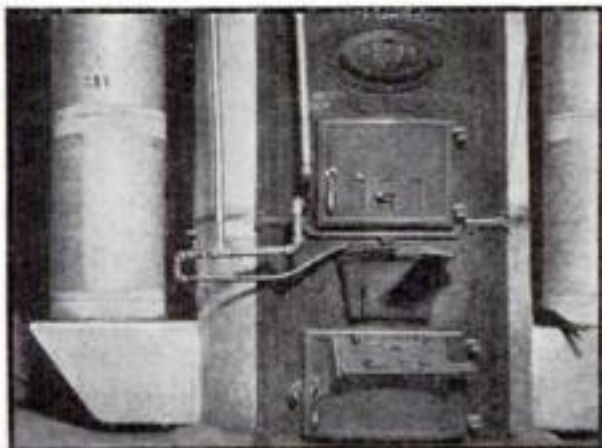


Each wagon is a box of 1/4 in. wood with two half-wheels fastened to the sides and a removable top. The elephant should be cut from plywood or made quite thick

Front and side views of one of the book ends. A full size pattern for cutting the elephant can be made by drawing 2-in. squares on a sheet of paper and copying in each what appears in the corresponding square in the drawing

PIPING WATER TO KEEP FURNACE PAN FULL

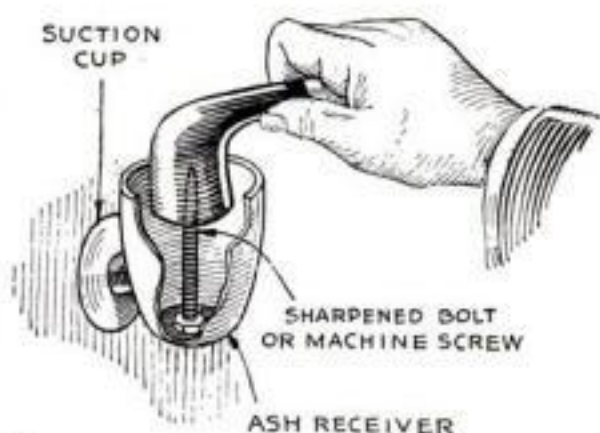
THE majority of hot-air furnaces, whether of the pipe or so-called "pipe-less" variety, have a water pan which must be kept filled in order to supply a certain amount of dampness or humidity to the air. To save himself the trouble of having continually to carry water to fill the pan, one home owner substituted a



Turning a valve is all that is necessary to fill the water pan of this hot-air furnace

pipe tee for an ell near the point where the pipe from the heating coil comes out from the fire box. Then, by means of a valve and a few fittings, he ran a piece of 1/4-in. pipe to a point over the water pan. This makes it a very simple matter to fill the pan whenever it is necessary to refuel the furnace. Previously the pan was empty most of the time, whereas now it seldom gets dry.—G. B. COUPER.

SUCTION ASH TRAY HAS CLEANER FOR PIPES



PIPE smokers find it difficult to knock out the ashes from their pipes on the suction-grip type of ash receivers so often used in automobiles and elsewhere. Even a moderately sharp blow is likely to dislodge the tray. It is therefore an improvement to fit a sharpened bolt or machine screw through the bottom of the ash receiver as shown so that it projects slightly above the rim. With the aid of this point, it is easy to remove the ashes or even a "heel" from the pipe.—R.W.

WRITING WITH INK ON THIN TISSUE PAPER

It is often desirable to letter or draw with ink on the wings of small flying stick airplane models, either for identification or for decoration. To do this neatly, place a piece of blotting paper directly under the section of the wing to be marked, otherwise the ink will be badly blurred.—ELMER McNUTT, JR.

HOW HE NEARLY LOST HER ... by ALBERT DORNE



6 WEEKS LATER



BEWARE OF "B.O."

WITH pores constantly giving off odor-causing waste, any one of us may unknowingly be guilty of "B.O."—body odor—unless we take precautions. Make sure of not offending. Wash and bathe always with Lifebuoy. Its creamy, abundant lather purifies pores—ends "B.O." danger. Lifebuoy's pleasant, hygienic scent—that vanishes as you rinse—tells you you're cleaner—safer!

Aids Complexion—Guards Health

Lifebuoy's bland, pore-purifying lather freshens dull skins—promotes healthy, radiant beauty. Helps protect health by removing germs from hands. Fine for shampoo. Adopt Lifebuoy today.



A PRODUCT OF LEVER BROS. CO.

TAPS and DRILLS



A handy new set of **MORSE** Taps and Drills Price (in U. S. A.) **One Dollar**

HERE for one dollar is a complete set of eight finely made Morse Tools—four machine screw taps with four drills in proper corresponding tap drill sizes. They will bring to your work bench the same fast cutting and accurate threading which has made MORSE taps and drills famous throughout the mechanical world.

Suited for machine or hand work, they will enable you to drill and tap holes in metal, bakelite, celluloid and other materials.



With the set comes a free copy of the Morse Tap Manual containing interesting information on taps and their uses. Send the coupon and a dollar bill to us or to your nearest Morse dealer.

MORSE
TWIST DRILL & MACHINE COMPANY
NEW BEDFORD, MASS., U.S.A.

Morse Twist Drill & Machine Co.
New Bedford, Mass., U.S.A.

I enclose one dollar for which send me postpaid Tap and Drill Set No. 32 consisting of four carbon steel Machine Screw Taps sizes No. 436, No. 632, No. 832, No. 1032, and four Wire Gauge Drills sizes No. 44, No. 36, No. 29, and No. 21.

Please send me free with this set a copy of the Morse Tap Manual.

Name
Address

How Was This Block Put Together?



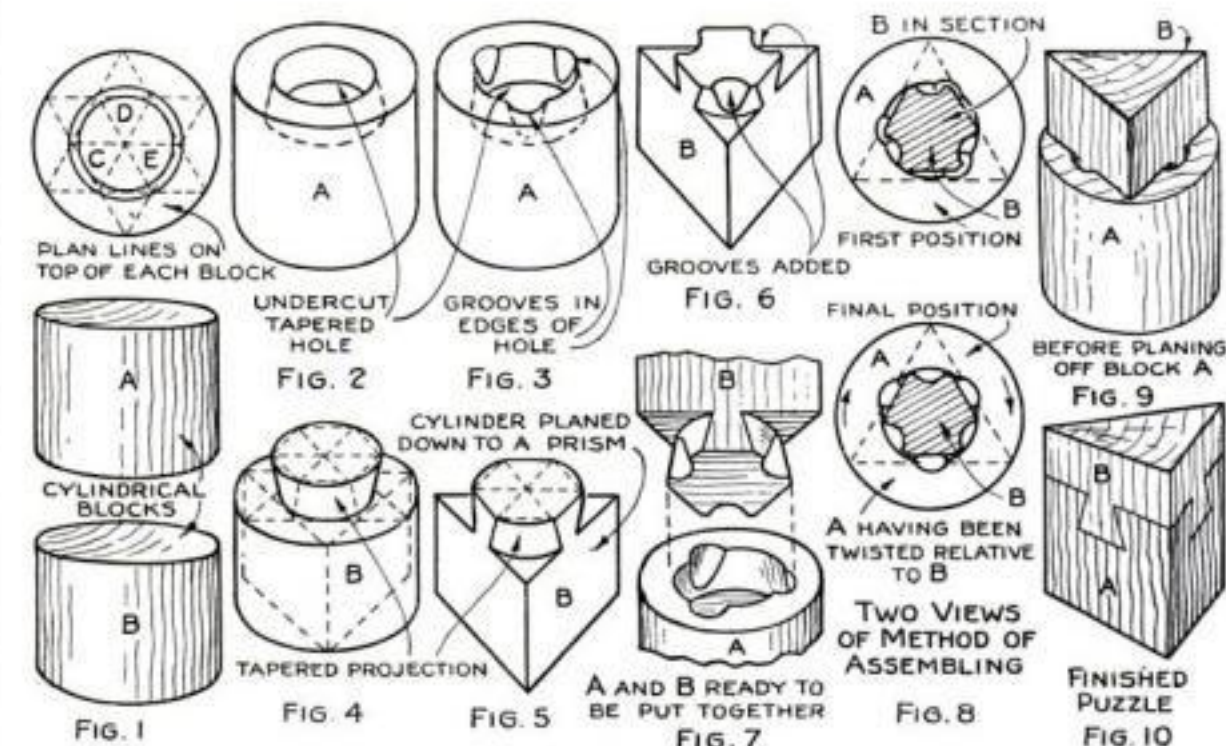
ARTHUR L. SMITH,
famous authority on puzzles,
devises another amazing new
woodworking stunt

drawn not more than $1/16$ in. greater in radius; perhaps a little less is better.

Two blocks, preferably of contrasting colors, are turned to 3 in. in diameter as shown in Fig. 1. Their length is immaterial. One block (hereafter referred to as block A) is bored out in the lathe to a depth of $1/2$ in. as shown in Fig. 2. This hole must taper from the size of the smaller circle in the diagram, Fig. 1, to the size of the larger circle at the bottom. Block B, shown in Fig. 4, must have a corresponding projection that tapers from the larger circle at the top to the smaller one at the bottom. It is well to lay out the star on the top surfaces of both blocks in order that the matching cuts can be easily made in the exact positions on both pieces.

Block B is now planed to shape as in Fig. 5. The plane must be very sharp and set to take off light shavings. Rounded bevels or tapering grooves must now be gouged out of this block as indicated in Fig. 6.

The corresponding bevels on block A are gouged out of the central part of each point of the star as in Fig. 3. The width must not be greater than the smallest width of the dovetail except in the angles marked C, D, and E in the diagram, Fig. 1. Place block B on block A in the position indicated at the top of Fig. 8. If it can be forced down into the hole, all is well; if not, a little more mate-



The secret of the mystifying dovetails which seem to fasten these blocks together lies in the way in which the projection on block B is twisted into a corresponding recess in block A

rial may be cut out of the angles *C*, *D*, and *E* in both blocks. Remove the wood from the angles carefully so as to obtain a snug fit.

The meeting surfaces now should have glue applied to them, and block *B* is inserted in block *A* and twisted around to the position shown at the bottom of Fig. 8.

The blocks are pressed in a vise or held with a hand screw until the glue is hard. Afterwards block *A*, which appears as shown in Fig. 9, is planed off to coincide with block *B*. The writer found it best to plane down to within about 1/16 in. of the right size and finish with a file and sandpaper to avoid nicking out the fine points of the dovetail angles. The better the craftsmanship, the more perfect the joint will appear. In no case, however, is there much likelihood of the method's being discovered by the uninitiated.

ONE WAY TO SOLVE OUR MAGIC SQUARE PUZZLE

WERE you able to work out a solution to the magic square puzzle in the last issue (P. S. M., Feb. '32, p. 106)? If not—and if you enjoy puzzles of real merit—look up your copy of last month's magazine and try to do so now before reading further and learning the solution.

15	2	19	6	23
22	14	1	18	10
9	21	13	5	17
16	8	25	12	4
3	20	7	24	11
A	B	C		

Position of blocks before being moved

For convenience, the three plain blocks have been designated as *A*, *B*, and *C* on the accompanying diagram. *A* is removed at the beginning. Then the secret of success is simply to transpose by moving the oblong block *B* and the remaining square block *C*, as follows:

B 24 7 25 12 4 11 7 25 20 3 16 8 3 20 12 4
11 17 5 13 4 3 21 14 1 4 3 11 13 18 10 5 18 10
6 23 5 18 10 6 23 19 2 1 22 15 1 2 4 3 6 23 19
4 3 6 23 10 18 19 10 18 17 7 C 24 25 13 7 17
19 10 18 7 13 12 20 21 11 23 14 22 6 18 7 14
18 7 14 18 22 9 8 11 23 22 9 8 15 6 7 14 18 9
8 15 6 7 14 8 15 14 8 18 9 15 18 8 7 6 11 16 21
23 22 13 12 20 23 22 13 18 14 13 18 12 17 19
15 14 13 18 12 17 14 13 18 12 17 18 13 14 19
C 20 25 B 21 16 17 18 19 C 20 25 23 22 16 17
18 19 C 20 25 23 22 C 19 18 17 16 C 22 23 25
20 19 18 17 16 21 B 24 25 20 19 18 17 16 21 C
22 23 24 B C 21 16 17 18 19 20 25 (214 moves)

This may not be the minimum number of moves, but it is probably less than the average solver will take. If you find you can solve the puzzle in fewer moves, please send a copy of your solution to the Home Workshop.

SANDPAPER SHEET HOLDS OILSTONE STEADY

MANY mechanics set an oilstone in a vise so that it will not slip around while tools are being sharpened. The same result can be obtained without that trouble simply by folding a sheet of sandpaper in two, rough side out, and placing it under the oilstone on the bench.—SAVINO CAP.

YOU'LL WANT THIS BOOK

CARBORUNDUM

REG. U. S. PAT. OFF.

ANNOUNCES A NEW ISSUE OF THIS PRACTICAL POPULAR WORK

SOME ADVICE ON HOW TO



Fig. 1
Holding the stone in the proper position for sharpening.

For if this is done the steel that is removed will adhere to the stone, which will at once have its best cutting quality—the most desirable characteristic of high-grade sharpening stones.

4—Hold the planing with both hands, as indicated in Fig. 3 and move it backward and forward a half-dozen times with the most pressure on the forward stroke. When beginning this operation, place the tool on the stone at a very low angle and raise it gradually until the tool lies flat on the surface of the stone. It may be necessary to adjust the planer slightly from



These Carborundum Sharpening Stones are recommended by the U. S. Army, Navy, and Air Force.

SHARPEN WOOD-WORKING TOOLS



Fig. 2
Finishing off the edge.

side to side to keep the edge straight. To be sure that the edge is straight, it is best to lift it up and look at it from the side. If a level surface level is just what you want, just the way to

Even if you had our first book, you'll want this new one, too

ADVICE ON

How to SHARPEN WOOD-WORKING TOOLS

Published by THE CARBORUNDUM COMPANY • NIAGARA FALLS, N. Y., U. S. A.
CANADIAN CARBORUNDUM CO., LTD., NIAGARA FALLS, ONT.

THIS book in its original form proved so popular that six editions totalling many thousands have been sent to home craftsmen, contractors and carpenters throughout the U. S. A. and Canada. It was planned and written by Emanuel E. Ericson, well-known expert craftsman. Everything about sharpening edge tools and the proper use of Carborundum Brand sharpening stones given in most careful detail.

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Send me your New Issue P-1 of "How to Sharpen Wood-working Tools"

Name _____

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**Have you seen
these new
MAYDOLE Tools** ?

Now you can have the famous Maydole Hammer quality in a new line of tools by Maydole. The patented, improved Stillson Type Wrench—the Norwich Hammer—the Maydole Hatchet—and the Maydole Non-Mushrooming Cold Chisel—each one is built with the same high craftsmanship that has characterized Maydole Hammers for over 100 years.

Special Introductory Offer

Until March 31st, 1932, you can obtain any or all of the new Maydole tools at a special discount of 25%.

Just fill in the coupon below and take it to your nearest Maydole dealer—see for yourself the tool value in these new Maydoles. Make your selection, pay only the low introductory price—save 25% by doing it now. If your dealer does not carry the new Maydole Tools, send us his name and we will see that you are supplied.

**David
MAYDOLE**
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This coupon, when properly filled in and presented to a Maydole dealer, is good for a 25% discount on one of each or any of the new Maydole Tools.

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Maydole Dealer is:

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City and State _____

This is an introductory offer and expires March 31, 1932

25%

TAKING PHOTOGRAPHS UNDER WATER

AN INEXPENSIVE "photoscope" for amateur underwater photography can be made with a few pieces of $\frac{5}{8}$ -in. wood, a sheet of plate glass 7 in. square, some waterproof glue and putty, and a small can of shellac. The box illustrated is $8\frac{1}{2}$ by $10\frac{1}{2}$ by $12\frac{1}{2}$ in. and was built especially for a graflex camera, which rests tight against the glass window. Of course, any camera with a fast lens can be used.

The "photoscope" should be built slightly larger than the type of camera to be used. For best results, a good camera lens is essential because the light available for underwater picture taking is so much less than normal.—ORMAL I. SPRUNGMAN.



Above: The box ready to be submerged. Behind the little window is a graflex camera. It was with this device that the photograph shown at the left was taken. A good lens is essential for such snapshots

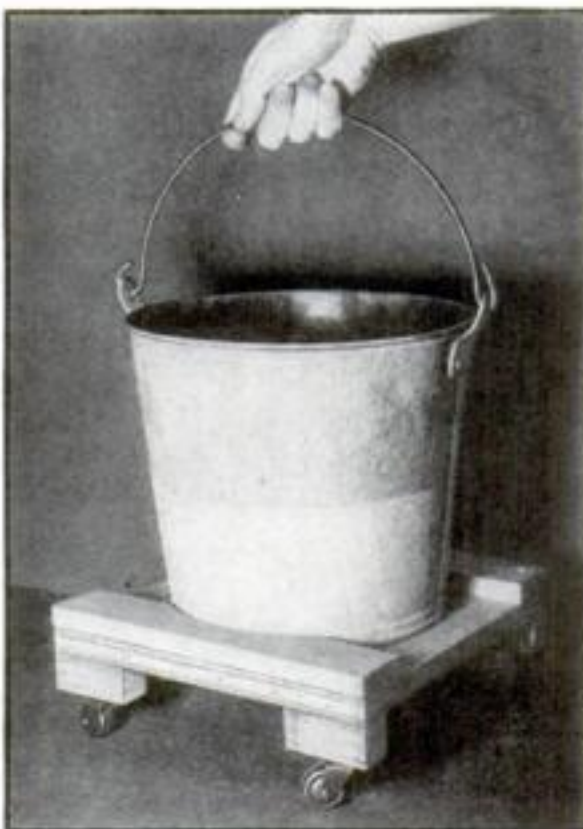


THIN FILM OF GREASE STOPS SPOUTS FROM DRIPPING

A THIN film of grease applied just below the spout of a beaker, graduate, or other container will prevent the liquid contents (if basically water) from running down the side. Ordinary paraffin will serve, or any wax or grease that happens to be handy. This is an especially good kink to remember when making chemical experiments. In a similar manner, a little butter rubbed below the cream pitcher spout will prevent dripping.—ROY ELTON.



Rubbing grease below spout of graduate to prevent water from dripping down on the outside



Roller platform for a scrub bucket made of scrap pieces of wood and four cheap casters

SCRUB BUCKET EASILY MOVED ON CASTERS

IF A SMALL platform fitted with casters is provided for the scrub bucket, it will save much unnecessary lifting and reduce by that amount the drudgery of house cleaning. The little truck is merely a square base made from $\frac{3}{4}$ -in. boards, with cheap casters under the corners and two strips of wood on top, if desired, to form a sort of recess which prevents the bucket from slipping off. Casters of the plate type can be screwed directly to the base, but casters which have long stems require blocks to be placed under each corner. The latter type of caster was used in making the bucket holder illustrated, so blocks had to be added.—E. B.

ASH TRAY REDUCES FIRE HAZARD AT BENCH

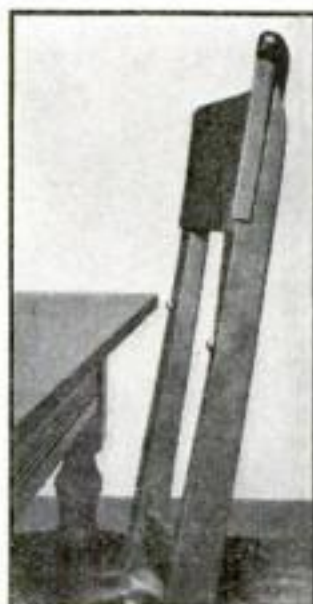
Using a bud holder to put out "butts"



THE danger of leaving lighted cigarettes to burn away on the workbench and perhaps fall or roll into shavings and other inflammable materials can be avoided by placing a ten-cent glass or porcelain "bud holder" on a regular ash tray or any suitable dish or tray. Instead of merely laying a cigarette down, set the lighted end in one of the holes running through the bud holder. It will go out immediately. Since the end is not crushed, the cigarette can even be relighted and smoked again.—H. B. SHUMWAY.

PROTECTING FURNITURE USED BY CHILDREN

CHILDREN'S furniture, especially if made of soft wood, and, for that matter, full size furniture used by children, can be protected from being bruised and scratched to a considerable extent by the judicious use of rubber-headed nails or small disks of felt at points where the pieces are likely to strike each other or the walls and woodwork. For example, when a chair is repeatedly pushed under a table in such a way that its back strikes the edge of the table top, both pieces are likely to be marred, but small rubber-headed nails inserted in the chair as shown will prevent this.—W. L. FAUROT.



Bumpers on chair prevent bruising

LIQUID WAX LUBRICATES STIFF WINDOW SASH

SLIDING window sash and large, heavy drawers can be made to open more easily by applying one or two coats of ordinary liquid floor wax to the slides and contacting parts. After a window sash and frame have been painted and the paint is nearly dry, run a thin bladed knife between the sash and the stops to cut the film.—ROGER L. BRIDGEMAN.

How CASCO Mended A Broken Heart...

"I've used Casco for practically all my gluing work," writes J.A.L. of Louisville, Ky., "from mending wood to BROKEN HEARTS! My little girl dropped her doll..Smashed its head ..She was broken-hearted..but CASCO, like a good friend, repaired the doll's head..and so mended a broken heart!"

This actual letter is but one of the many we have received from men who told us how they used their samples of Casco. Send for yours today—and see how useful the strongest glue made can be TO YOU.

It Fixed the Glass on My Watch

"I broke the crystal of my watch and had it replaced with unbreakable crystal, which dropped out twice by a jeweler—but dropped out a third time. I then tried CASCO and it has been secure ever since."
—P. G. R., New Ulm, Minn.

It Saved an Expensive Linoleum Floor

"Two years ago, I had my office floors covered with best inlaid linoleum...and constant washing separated the joints, so that no matter what kind of glue I used they soon separated again after washing. Three months ago I used Casco, weighted the linoleum down over Sunday — now try and separate the joints—water won't!"—Dr. L. P. B., St. Paul, Minn.

Now..TAKE YOUR
SAMPLE of
CASCO WATER PROOF GLUE
and do expert gluing jobs
on **EVERYTHING!**

By actual test, Casco is the strongest glue ever made—and yet, it's so simple to use, that you can't go wrong. All you do is mix it in cold water from the tap—and Casco is ready!

Take this large trial package of CASCO—and also our FREE folder of uses, showing you how to do things with Casco you never thought glue could do—cementing linoleum—and gluing almost every kind of material; making waterproof kalsomine; crack filler; etc. Casco is so easy to use, that even if you never glued anything before, you're sure to get perfect results on your first job.



My Treasured Pipe It Fixed

"The other day I dropped my favorite, imported pipe. The stem had a piece completely broken, where the bit enters, and was not replaceable in this city. But an application of Casco—and a night in a small clamp repaired this pipe so well that no one has ever noticed the break!"
W.F.S., Lafayette, Ind.

Permanently Patched My Son's Overalls

"My son continually tore the knees out of his overalls and stockings. In despair I took some leather patches and stuck them on his overalls with Casco. Since then, I have washed and ironed them many times...still the patch sticks...thanks to Casco. It sure saved me work and money!"—Mrs. W. A. Hornell, N. Y.

Send This
COUPON
for YOUR
SAMPLE

THE CASEIN MFG. CO. OF AMERICA, INC.
205 East 42nd St., New York, N. Y. P.S.M. 3-32
Here's my 10c (stamps) for which please send me your trial package of CASCO Waterproof Glue.

Name.....
Street.....
City..... State.....
And here's my dealer's name and address (paint, hardware, or lumber dealer).....



Try this extra-moist lather for quicker, easier shaves

... keeps beard soft and limp from start to finish

MEN, here's a new, richer, heavier, extra-moist lather that will wilt your wiry whiskers in a jiffy. With it you'll follow through for the quickest, smoothest, snappiest shave ever.

Light, frothy lathers can't give you a good shave—they dry too quickly. But laboratory tests show that Lifebuoy lather will hold 52% more moisture than ordinary lather. It douses your beard—keeps it soft and limp—so your razor cuts it close and clean without slicing, pulling, topping or chopping.

Try it—for a par-breaking easy shave

For your next shave lather with Lifebuoy. Notice how the razor sails over your face—smoothly as a perfect drive sails down the fairway. See how clean—how satin-smooth—how cool and refreshed your face feels afterwards.

Get the big red tube of Lifebuoy Shaving Cream at your druggist's today. Or write for a free trial tube to Lever Brothers Co., Dept. H-3, Cambridge, Mass.



BLUEPRINTS

to Help You in Your Home Workshop

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. These prints are the result of a pioneer effort begun by this magazine in 1922 to provide readers with authoritative drawings at a nominal price. This service has grown to be by far the greatest of its kind. It is conducted solely for your benefit, so do not fail to take advantage of it at every opportunity.

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Rise-off-Ground Tractor, 3-ft., 50.....	25
Seaplane, Tractor, 30-in., 87.....	25
Seaplane, Morris (Record 12½ min.), 102.....	25
Single Stick, Tractor, 30-in., 82.....	25
Tractor (Record Flight 6,024 Ft.), 104.....	25
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Amplifier, Three-Stage, Audio-Frequency, 42.....	25
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Doll's House Furniture, 73.....	25
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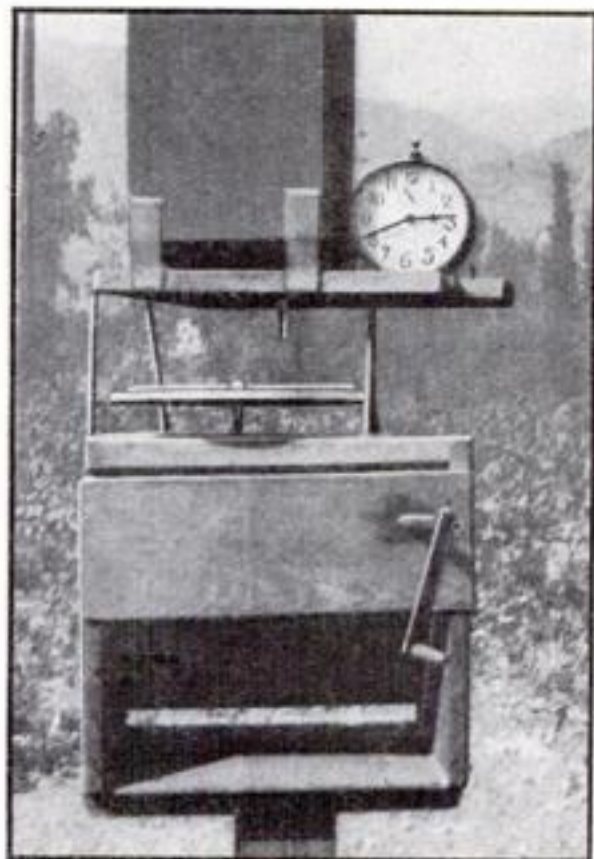
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CHICKEN FEEDER THROWS GRAIN OVER WIDE AREA

WHEN it is feeding time in the poultry yard, the automatic device illustrated below calls the chickens by means of an alarm clock and then scatters grain within a circle of about 40 ft. in diameter. The motive power is an old spring phonograph motor from which the governor has been removed. This is mounted in a box on a post set into the ground in the center

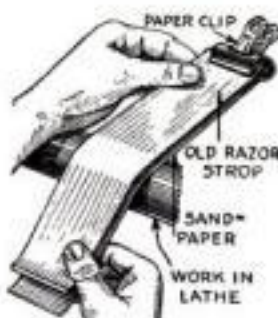


When the alarm goes off, grain falls on the phonograph turntable and is scattered widely

of the chicken yard. On the phonograph turntable are two crossbars to scatter the grain. Above is mounted a funnel-shaped hopper with an easy working door to close the lower opening. The alarm clock alongside the hopper has a spool on the alarm key. When the alarm goes off and the bell rings, the spool revolves and winds up a cord, and this turns on the grain and operates a trigger that sets the turntable spinning, causing the crossbars to throw the grain.—ROY E. HILL.

LATHE WORK SMOOTHED WITH SANDING STRAP

WHEN work is being sanded in the lathe, the sandpaper becomes heated by friction and often tears at the end which is held in the hand, especially if much pressure is exerted. This may be avoided by backing up the sandpaper with an old razor strop. The sandpaper is cut the width of the strop and both are clipped together at one end by a large spring paper clip or a spring clothespin. By this method the usefulness of the sandpaper is considerably prolonged. If a discarded strop is not available, any strip of heavy canvas or other comparatively strong cloth may be used.—CLINTON F. BLAKE.



Sandpaper strap for use on wood turnings

NEW!

BOICE-CRANE



Only
\$32⁵⁰

Tilt Your Saw Not the Table

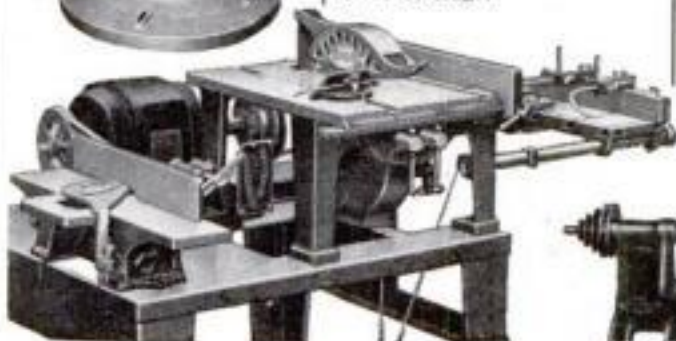
No more toboggan-slide tilting tables. This Boice-Crane large, highly polished, 15" x 17 1/2" table ALWAYS REMAINS LEVEL. All ripping, cross-cutting, dadoing, bevelling, rabbeting done on level table. Lumber can't slide down against saw. No binding, no wedging. The ARBOR tilts, raises and lowers. Nothing else like it. No shop complete without this modern saw. Weighs 80 lbs. Larger table—20" x 27 1/2"—if desired. Full details in new catalog—send for it.

Shaper \$49

Has 17" table. Correct design—spindle raises and lowers. Ball Bearing. Speed 7000 r.p.m. Weighs 80 lbs. Can be supplied with electrically reversible motor.

Mortiser—

Cut below shows mortiser attachment. Routes, bores and mortises. Full 1/2" chisel capacity. Foot pedal gives powerful leverage.



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Cut above shows our 4" ball bearing Jointer mounted on steel stand. Fence tilts two ways. Long polished tables. Wide rabbit arm. Price Jointer only, less guard, \$24.50

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And the right way to find the answer is to line up in front of a Daisy Target with a Daisy Pump Gun, and see who can put ten shots closest to the bulls eye.

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Fill out the coupon below, get the Daisy Target, and a copy of the Daisy Manual, which tells boys how to shoot and drill. It's free to any boy who sends this coupon.

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Special Target Offer!

To make your shooting outfit complete, get one of the new Daisy Targets, made of sheet steel, with patented device to stop shot from flying. Folds to fit pocket, and can be set up anywhere, for rainy day practice, in house, cellar, or garage. Only 50 cents—If you accept our special offer on coupon below.



DAISY

AIR RIFLES

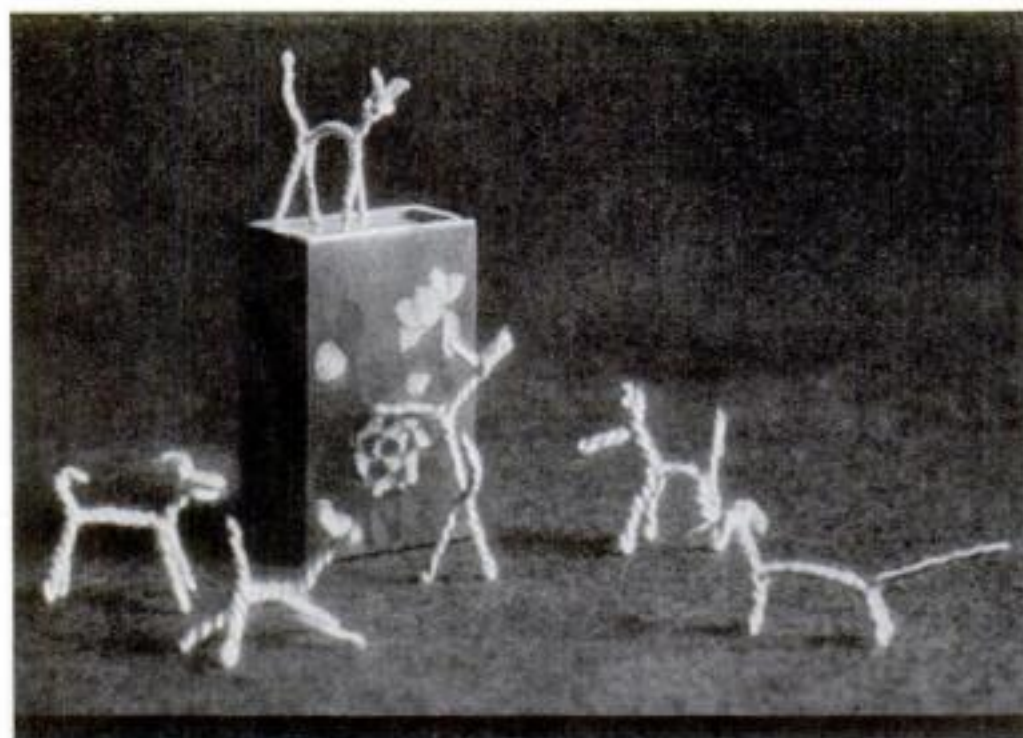
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Gentlemen:

Enclosed find 50 cents for which please send me one of your Daisy Folding Steel Targets. I am to receive absolutely FREE, a dozen extra target cards, a tube of Bulls Eye Steel Shot, and a copy of the Daisy Manual, containing instructions for drill and target practice.

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Address (Street and Number).....

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Amusing Crêpe Paper Figures

By
DOUGLAS LEECHMAN

TOY dogs and other animal novelties are sometimes made from pipe cleaners, but similar and in some respects more unusual results are obtainable with nothing more than crêpe paper.

Start with a strip of crêpe paper about 1 in. wide, torn from the edge of a paper napkin parallel with the grain. Twist this strip as tightly as possible between the thumb and forefinger, forming a long thin thread which will, with the average napkin, measure about 11 in. When no more twisting seems possible without breaking the thread, allow it to kink in

the middle, forming a double, twisted cord. This should, in turn, be tightly twisted.

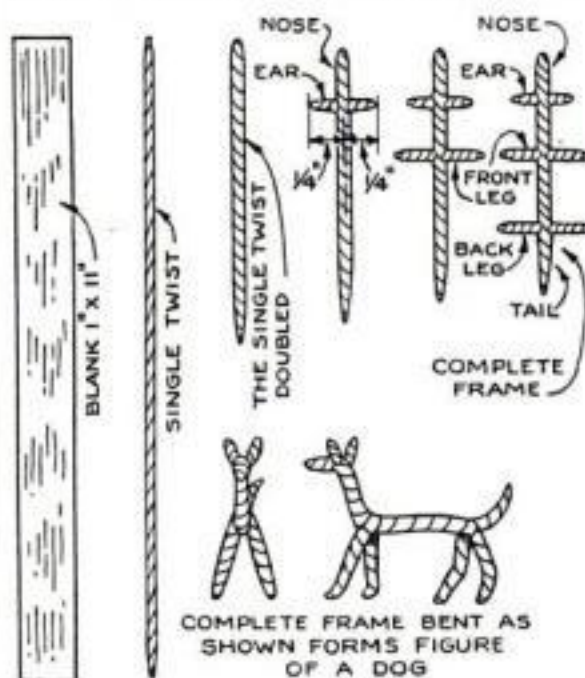
At a point about $\frac{3}{4}$ in. from the "loop" (originally the middle), pull the two units slightly apart and form two small branches, each about $\frac{1}{4}$ in. long. These will twist on themselves, a tendency which should be encouraged with an additional few twists, thus forming the ears of the dog.

Nearly $\frac{1}{2}$ in. farther down, slightly longer branches are pulled out for the front legs; and 1 in. farther along, the back legs are brought out, leaving a short length for the tail, which is composed of two free ends twisted on themselves.

Now bend up the ears, adjust the neck to the proper angle, turn down the legs, curl up the tail, and press and twist the various parts into the desired positions.

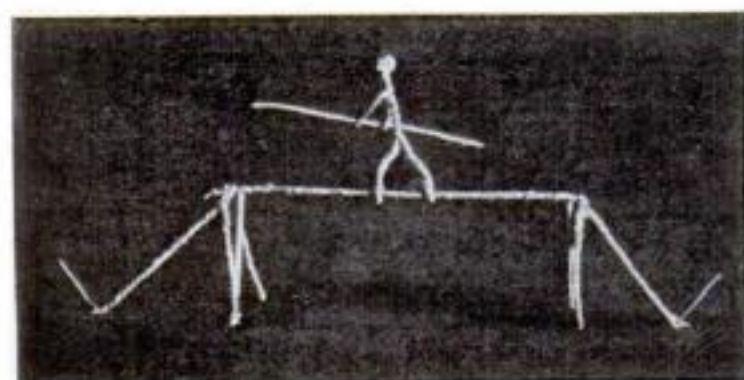
A cat is made in the same way, except that the head is formed by tying a knot in the end of the double cord which forms the tail in a dog, and the two free ends are then teased out to make the cat's ears. A man is similarly made except that the ears are suppressed and the "tail" is absorbed in shaping the legs. Women may be represented by adding a small triangular skirt. Men and women may be made to stand by providing the man with a walking stick and the woman with an umbrella, thus providing three-point supports.

Attached to a slip of bristol board with a drop of glue under each foot, these paper figures make excellent favors and place cards, and manufacturing them is a never-failing source of amusement to both children and grown-ups.



These are the steps in making one of the "paper pups." The crêpe paper must be twisted very tightly so that the novelties will stand up

In this little scene the tight rope, after passing through loops in the man's feet, is supported by matches and held at the ends by pins. The balancing pole, which is made of a single thin thread of paper, passes through loops in the figure's hands



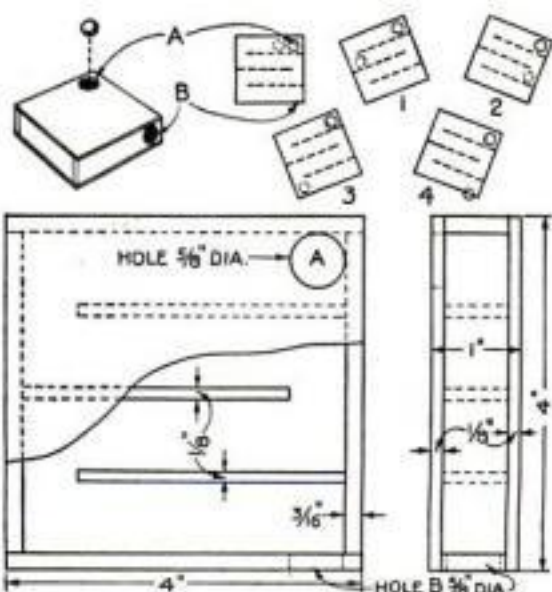
MARBLE ROLLING PUZZLE TESTS ONE'S SPEED

IT WOULD seem to be a simple matter to drop a marble into one hole in this innocent looking little box and let it roll out of the other, but there is a trick to it. You can have a good deal of amusement in watching your friends try to do it, especially if you fix a time limit of ten or fifteen seconds. Tell them to tip the box



When you give this puzzle to your friends, set a limit on the amount of time allowed

in any way they wish. Actually, the marble can be rolled through in about four seconds by dropping it into hole A, then standing the box on edge with hole B down and tilting it edgewise, first to the left, then to the right, next to the left, and finally to the right. This method is made necessary by the arrangement of the three partitions, which are placed as shown in the drawings below. The ends and sides of the box should be made from a scrap of wood about 3/16 in. thick, and the top, bottom, and partitions from a piece 1/8 in. thick. A coat of paint or stain will improve the appearance of the puzzle box.—DONALD W. CLARK.

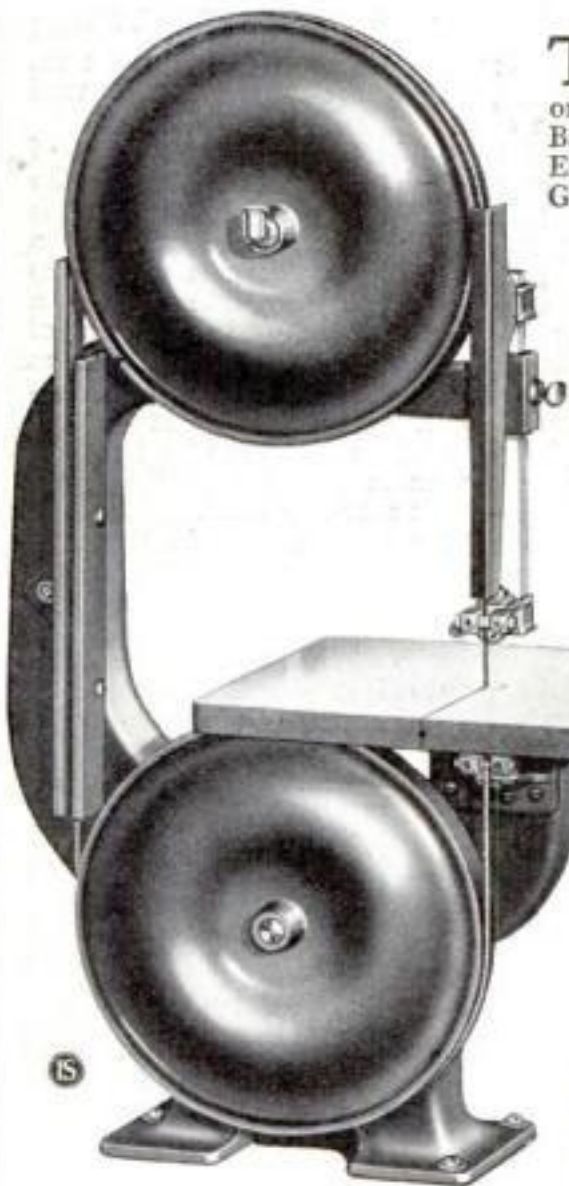


Drawings of the box and sketches showing how the box is tilted to roll the marble

POLISHING SHORT WORK

To POLISH and round off the ends of small pieces of rod after they have been filed, place them one at a time in a hand drill or brace and turn them on a piece of emery cloth laid on a heavy piece of felt.—WILLIAM HOTMER.

New Delta Band Saw Wins Woodworkers' Approval



THE new, improved 1932 DELTA Band Saw has already passed its workshop tests with flying colors. The absolutely Rigid Frame, Balanced Disc Wheels, Ball Bearing Blade Support, Accurate Tilting Table, Easy Tensioning Device, Large Capacity, and Special Guides make this an exceptionally safe, accurate, fast-cutting machine capable of giving years of good service. Woodworkers everywhere are also welcoming the new Delta Band Saw "Sanding Belt"—an unique attachment that eliminates many tedious hand sanding operations.

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USER AGENTS

We pay you BIG MONEY! Just for showing your radio to friends and neighbors. Easy EXTRA MONEY! Check coupon for details.

TAKING GHOST PICTURES

(Continued from page 85)

photographs, in the same finished picture. It is necessary only to mark the proper position and size for each one on the ground glass and make successive exposures for each. Of course, a black background cloth is used in each case.

Aside from ghost pictures, all sorts of amusing trick pictures can be taken by the same general method. A typical example is the picture of a man or woman inside a hug glass bottle. In this case a close-up view of the bottle is first taken against a fairly dark background. The position of the figure is marked on the ground glass as though it were inside the bottle, and an exposure is made. As with the ghost pictures, the plate or cut film holder is then removed, and the camera is moved until the figure, standing against a totally black background, appears on the ground glass in the right size and at the right place. A second exposure completes the job.

The plain ghost picture first described is easy to take with any type of camera, as no special apparatus is required. Other double-exposure ghost pictures and the various trick photographs such as the figure in the bottle are difficult with the ordinary roll-film camera because there is no way of determining the position of the image on the film.

A large sheet of dead black cloth is about all that is needed for double-exposure picture if your camera permits focusing on a ground-glass screen. A good, solid tripod is, of course, a necessity.

Another interesting trick photograph that can be taken with any type of camera is the picture which shows the same person in two different positions. As it is obvious that one person cannot be in two different places, such a picture always proves mystifying.

A picture of this type is shown at the bottom of page 85. Here we see a man seated in two different chairs in two different positions in the same picture.

Photographs like this are made with the aid of a simple mask placed over the lens of the camera. The illustration in the oval on page 85 shows such a mask. It consists of a thin cardboard rim to fit over the camera lens. Attached to it is a circle of black paper. A small opening is cut in the paper. This is formed by drawing a straight line across the disk near one edge and cutting out along the straight line and that portion of the circular edge between.

THE camera is set up as firmly as possible on the tripod. Then the mask is placed over the lens with the opening at one side—the side toward which the man is sitting. A normal exposure is made. The man now shifts over to the other chair, and the paper mask is rotated till the opening is at the opposite side. Another exposure is given.

Once the proper combination of mask opening and lens stop has been worked out, taking this type of double exposure picture is quite simple. The idea, of course, is that the mask permits only one side of the negative to be exposed at a time; and the opening in the mask should be such that the two exposures overlap at the center so that no dividing line will appear. The difficulty lies in the fact that the proper mask opening varies with the lens stop used, the type of lens, its focal length, and so on. Consequently, you will have to do some experimenting before you get a perfect blend at the center of the picture. If the opening is too wide or the lens stop is too large in proportion to the mask opening, a dark vertical streak will appear in the center of the picture. If the mask opening is too small or the lens stop too small in proportion to the mask opening, there will be a white streak up and down the

\$10 for the best TRICK PHOTO

POPULAR SCIENCE MONTHLY will pay \$10 for the most photographically perfect trick picture taken by double-exposure or any other method and submitted on or before April 1, 1932. The only condition is that it must be taken during the months of February and March, 1932, by an amateur. Any type of camera may be used, and the developing and printing may be done by a professional. Mail both print and negative to the Photographic Editor not later than April 1, and mark your entry "March Photo Contest." If you wish the print and negative returned, send a self-addressed, stamped envelope with your entry.

Winner of Sixth Contest

P. A. Kinsey, of Boyertown, Pa., has been awarded the \$10 prize for the best picture in the photographic contest announced in the sixth article in the series (P. S. M., Nov. '31, p. 92). Those entrants winning honorable mention are as follows: C. H. Clapper, Hudson, N. Y.; Cyrus G. Cooper, Royal Oak, Mich.; A. W. Grumbine, West Lawn, Pa.; H. B. Henrickson, Washington, D. C.; L. A. Huber, Clinton, Iowa; R. Litzenberger, Manheim, Pa.; Harrison N. Mucher, Reading, Pa.; Durward B. Phelps, New Albany, Ind.; Howard F. Reed, Springfield, Mass.; Mrs. George Ringel, Hamilton, Ontario, Canada; Wilk H. Works, Vevay, Ind.; William Worst, Lockport, Ill. The winner of the December, 1931, contest will be announced next month.

middle of the picture.

The quickest way to work out the combination is to make a mask with an opening about one fifth of the distance across the lens and try six exposures one after the other, starting with the largest stop and using a smaller stop each time. After seeing the result of these test exposures, you probably will hit the precise combination on the next roll of six pictures. Of course, if all the pictures on the first test roll show a white streak, the opening in the mask should be made wider, and vice versa. Remember that the camera must not be moved between exposures and that the two exposures for each picture should be exactly alike. Furthermore, the proper exposure will be several times what you would normally give for that particular lens stop.

This particular type of trick photograph sometimes is of practical value. For example, the photograph of the child taking a book from a row supported by two book ends on page 104 was made by double exposure, as only one book end was available. This single book end was photographed at both ends of the row of books by the method outlined.

Another article by Mr. Ryder is scheduled for the April issue.

JIG-SAW PUZZLES ARE EASY TO MAKE

(Continued from page 80)

Feed the wood slowly and at a uniform rate, as the quality of the finished cut depends on the manner of handling. After a little practice the amateur will find he can make the cuts easily and without guide lines. However, if the beginner desires to draw lines to guide his cuts, the following method, which eliminates the necessity of marking up the surface of the picture, is recommended: Cut a sheet of tracing paper to a size equal to the 1 in. oversize dimensions of the plywood and moisten it thoroughly. Then coat the four edges of the paper with glue for a width of $\frac{3}{8}$ in., forming a border of glue around all four

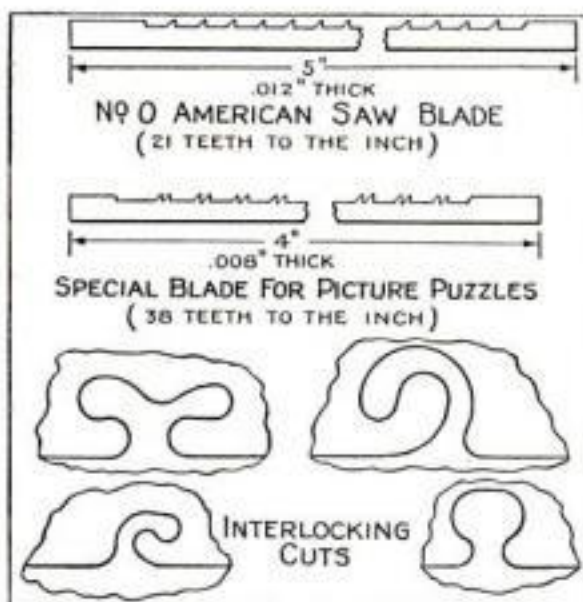


Fig. 2. Saw blades recommended for picture puzzles and examples of interlocking cuts

sides. Next, place the tracing paper over the picture and smooth down the edges, being careful to see that no glue gets on the face of the picture. Allow the glue and paper to dry overnight. The guide lines then can be drawn on the tracing paper. The paper is wetted so that on drying it will stretch taut over the picture.

Many commercial picture puzzles are assembled of pieces which have been cut to various shapes to represent familiar objects and letters of the alphabet. This adds a certain novelty to any puzzle, but it is a patented feature and cannot be used in making puzzles to be sold.

If the cuts are made carefully and a good grade of wood used, the edges of the various pieces will be smooth. However, if partially rough edges do result, they can be smoothed up by rubbing them with a piece of bone, a gilder's agate, or an old toothbrush handle.

Experts at picture puzzle making have found that the interest aroused by a puzzle depends to a large extent on the choice of picture. The pictures should be attractive in themselves and should not contain too much of any one color. Pictures showing large expanses of sky, water, or grass therefore should not be used. Also, in pictures containing figures, the faces should not be cut across, but the complete face should form one piece.

By gluing a map of the United States to a piece of plywood and cutting along the border lines of the states, an interesting puzzle for children can be made.

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photographically illustrated booklet contains valuable information and hints for building ship models in addition to prices and full description of the above articles. Many people only slightly interested in models have become greatly enthused upon receiving this booklet. A copy will be sent postpaid upon receipt of 15cts. (coin preferred).

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With each Motor comes full printed directions, illustrated so you know exactly where each part goes—any boy who can read can do it. Besides the assembling will teach you a lot about motors and electricity. Send 10c in coin or stamps—west of the Rockies and foreign countries 5c extra—and you will receive your motor by return mail. NOTHING MORE TO PAY—NOTHING MORE TO BUY.

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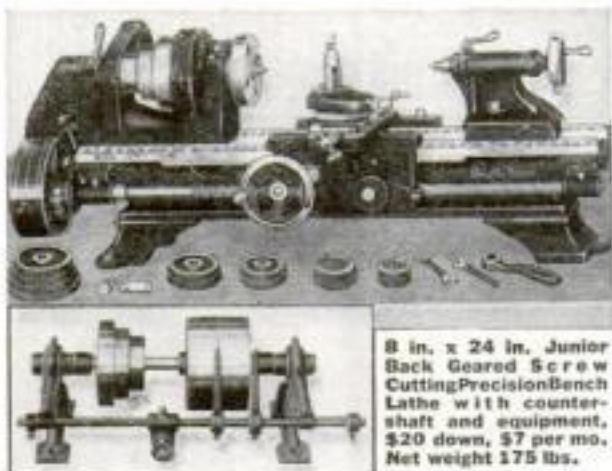


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Back geared headstock—cuts threads 4 to 40 per inch—six spindle speeds 43 to 675 R.P.M.— $\frac{1}{4}$ in. hole in spindle—set over tail stock for taper turning—Precision lead screw, $\frac{3}{4}$ in. diameter—Power feed to carriage—Sold on Easy Payments.

Available in bed lengths 24", 30", 36" and 42", with plain or compound rest; with countershaft drive and individual motor drive, bench and floor leg types. Can be driven from ordinary lamp socket.

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Name and Address

THE LATHE IN MODEL RAILWAY WORK

(Continued from page 98)

A tailstock, which is a cast metal frame, is fitted to the bed so that it can be moved along and clamped at any point. The tailstock carries a hollow spindle that is exactly in line with the shaft in the headstock. The spindle can be moved back and forth in the tailstock by means of a screw arrangement, and the end facing the headstock is internally tapered to match the headstock shaft hole.

Two tapered steel rods, with a 60-deg. point at the large end, are wedged into the tapered holes. These are called the live and dead centers because one turns and the other does not. A simple faceplate screwed on the shaft end and some means for supporting the turning tool are the only additional parts necessary to complete the simplest lathe.

ALTHOUGH it is possible to do excellent metal turning with a hand tool supported near the cutting edge by a rigid bar as in wood turning, it takes great skill to do good work. Even the simplest form of slide rest is much better for model railway work. The slide rest is a metal piece fitted to slide along the bed, and it carries a tool post in which the cutting tool can be clamped. As now made, the slide rest always has a mechanism that permits you to move the tool in and out to make facing cuts as well as lengthwise for straight turning.

From the model railway man's point of view, the next elaboration on this simple lathe is the type that has a back gear. If the pulley on the headstock shaft has three steps, the addition of a back gear adds three more slower speeds with correspondingly increased turning power.

In back-gear lathes the stepped pulley is mounted to turn freely on the headstock shaft with some form of lock which fastens it to the shaft when the back gear is not in use. A small gear is fastened to the small end of the pulley, and this engages with a larger gear on a shaft mounted back of the headstock shaft. On the other end of this extra shaft is a small gear that engages a large one rigidly mounted on the main shaft next to the large step on the pulley. The extra, or back-gear shaft, is mounted on an eccentric and a lever turns this eccentric mounting to throw the two pairs of gears into or out of mesh. The effect, of course, is to interpose between the stepped pulley and the lathe shaft or mandrel a double reduction gear.

Most thread cutting work on model railway rolling stock is of such small diameter that it is a waste of time to do it in the engine lathe. Except for an occasional special job, most of your thread cutting can best be done with small hand taps and dies. In many cases, however, you will find the lathe useful to help you start the taps and dies in a straight line.

YET even if you discount the value of thread cutting mechanism for cutting threads, it is still an exceedingly valuable because it supplies a very useful power feed for the carriage in taking long cuts on straight turning. Because of the smooth feed of the screw cutting mechanism, a better finish will be obtained. The screw cutting mechanism, in its simplest form, is operated by a train of gears from the headstock mandrel to a long threaded rod or lead screw, which is fitted under the apron or front section of the tool carriage. A split-nut clutch is fitted to the latter. The mechanism is so arranged that different gears can be fitted in the train to obtain the proper speeds of the threaded rod to cut fine or coarse threads.

The remaining lathe feature of special value to the model railway man is a compound rest. The ordinary tool rest, as already mentioned, is designed to provide both lengthwise

and crosswise motions. By means of additional parts, the compound rest provides an adjustment so that the tool can be fed into the work at any angle.

The tread of all wheels for model railways are slightly tapered. By setting the compound rest for this angle with the axis of the wheel, you can finish every tread to a perfectly uniform shape. The flanges, too, have a slight angle; they are not simply parallel sided disks on the edge of the tread.

PLAIN bars can be turned to smaller diameters by drilling a center hole in each end, placing the bar between the centers on the lathe, and driving it with a lathe dog clamped to the bar so that its tail sticks into the slot in the faceplate. However, a chuck that may be screwed on the mandrel in place of the faceplate is extremely useful for holding small rods, especially if a short piece is to be made from a long rod. The unused portion of the rod can be allowed to project through the chuck and the hole in the spindle. This saves cutting off and centering one end and also permits turning the entire surface with one setting of the work.

The three-jaw scroll chuck in which all three jaws move at once and which automatically centers round work is perhaps the most useful. The four-jaw independent chuck, in which each jaw is separately adjusted, will do anything that the scroll chuck will do, although it takes a lot more time to set up ordinary round work. In addition, irregularly shaped pieces can be centered in any way desired and it therefore permits various eccentric turning, drilling, or boring operations.

A small drill chuck with a taper shank so that it can be used in place of either the live or the dead center is vitally important; in fact, you can hardly get along without it.

As for the milling attachment, this is a relatively expensive piece of apparatus which will cost you from \$30 to \$40. It is a big help, especially if you are building steam type locomotives; but if you are handy with a file you can get along without it.

Another model railway article for beginners is scheduled for early publication.

WOODSMAN'S KNAPSACK

(Continued from page 86)

saturated. Squeeze out the excess, but do not wring. Immerse immediately in No. 2 and let stand a few minutes; then work the material around in the solution to insure a complete reaction between the soap and the sulphate solutions. Hang out to dry without wringing.

Straps. From the 9-in. piece of leather, cut off two strips 2 in. wide, the full length. Cut the remainder into 1-in. strips. Cut one of these strips into 4-in. pieces to be used for fastening the strap buckles to the sack. Cut three of them 24 in. long and save the 2-in. end pieces. Cut the remaining 1-in. piece in the middle, making two 13-in. pieces. Make straps of the three 24-in. pieces and the two 13-in. pieces by pointing off one end of each and punching a series of holes, large enough to take the buckle tongue, down the center, spaced about $\frac{3}{4}$ in. apart.

The two 2 by 26 in. strips of leather should be cut as shown at C.

Three of the 1 by 4 in. pieces are cut to fit the buckles by bending them double and cutting a slot in the center of the bend as at D, wide enough to accommodate the tongue and about $\frac{1}{2}$ in. long. The long narrow ends of the 2-in. shoulder straps are treated the same way. (Continued on page 117)

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WOODMAN'S KNAPSACK

(Continued from page 116)

Assembly. Holes must be punched in each buckle piece large enough to take the rivets. With the buckle in place and the ends together, punch two holes through both thicknesses of leather—one hole up near the buckle and the other out near the ends.

Three buckles are fastened to the sack cover—one at the center and one about 3 in. from each end. Place one thickness of leather above the cover cloth and the other thickness below it, and rivet together. Be sure that the front rivet goes through the hem of the cover as shown in diagram at E.

WHAT SIZE KNAPSACK TO MAKE

Size (Inches)	Material for Sack	Load
18 by 20	1 1/6 yd. 10-oz. duck, 30 in. wide	Day trips, 2 persons
22 by 24	1 1/2 yd. 10-oz. duck, 30 in. wide	Day trips, 4 persons
24 by 26	1 2/3 yd. 12-oz. duck, 30 in. wide	Ten-day trip, 1 person
26 by 28	2 yd. 12-oz. duck, 30 in. wide	Three weeks' trip, 1 person

Note: In all cases the material for the flap is the same—1/2 yd. 8-oz. duck, 30 in. wide.

The 24 in. long straps are riveted to the bottom of the sack with the ends at the very bottom—the fold—of the sack. The straps, which must be directly under the buckles, are fastened with two rivets. Use the 2-in. ends that were cut from the straps as reinforcements to be used on the inside of the sack.

The two 13-in. straps are riveted to the bottom of the sack, on the back, 1 in. from the outside ends, and are reinforced as the others were.

Buckles are riveted on the long ends of the shoulder straps. The D-ring is fastened to the other ends of the straps; this is done by using two of the 1 by 4 in. strips. The strip is passed through the ring and the ends riveted to the end of the strap as at F. The D-ring is fastened to the sack 4 in. below the edge of the top, in the center. The piece of leather is first riveted to the ring; then the whole is riveted to the sack—using the leather reinforcements inside as was done before.

Six equally spaced eyelets are put into the 3/4-in. top hem of the flap, and a light rope is passed through them, in and out alternately. Tie a knot in each end of this draw string so that it will not pull out.

Packing the Sack. In packing this sack, the blanket is first folded into a bundle about 24 in. square and placed so that it will come next to the back and act as a padding. The clothing and foodstuffs go in next, with the dishes last. The draw string is pulled tight and tied, the cover strapped down, and you are ready for the trail.

Tump Line. If extra heavy loads are to be carried, a tump or head line is needed. This line is made of a piece of 2 in. wide leather long enough to go around the forehead, with 1-in. straps fastened to the ends of it. Buckles are fastened to the ends of the sack about 1 in. below the top.

An article by Mr. Merrill on making moc-casins, the most comfortable of all footwear for outdoor use, is scheduled for April. Other camping articles will follow. The author is a well-known Maine guide.

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A close-up showing the tunnel stern with propeller and rudder further protected by sturdy skeg.



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A definite program for getting ahead financially will be found on page four of this issue

COFFEE TABLE IN MAPLE OR MAHOGANY

(Continued from page 79)

cabinetmaker's hot or hide glue, or high-grade liquid glue, as preferred; and two or three 1½-in. fine bristle paintbrushes for applying the finishing materials.

The parts of the coffee table as you will receive them consist of the following, which are illustrated in the photograph at the right:

One top *A* with molded edge.

Four scalloped rails *B* for top.

Two turned leg posts *C*.

Two feet *D*.

One top rail *E*.

One stretcher or bottom rail *F*.

Two turned gateposts *G*, notched at top.

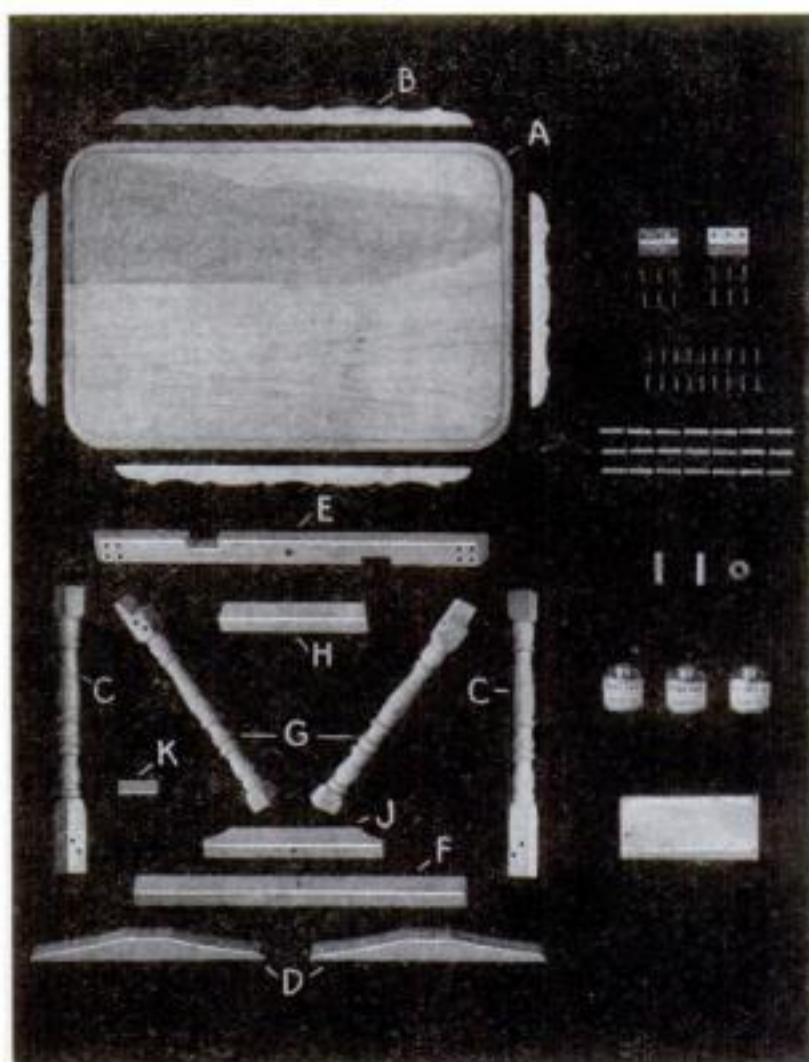
One upper rail for gate *H*, bored for pivot.

One lower rail for gate *J*, bored for pivot.

One block *K* to be sawed in half for making two stops.

Hardware: 1 pair brass hinges; screws for hinges; screws for fastening scalloped rails to top; 1 metal washer.

All necessary 5/16-in. dowels for joints, and two ½-in. dowels for the gate pins.



This is the complete coffee table kit. The parts are made to Guild specifications from the best obtainable materials

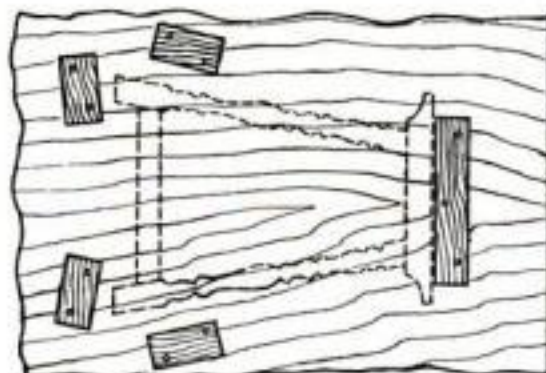
Three cans of the Guild's new process finishes and sufficient cheesecloth for making the necessary pads.

Since the parts are ready for assembling as you receive them, the first step is to make a trial assembly without glue. Attach feet *D* to leg posts *C* with dry dowels, and fasten top rail *E* and bottom rail *F* to the leg posts.

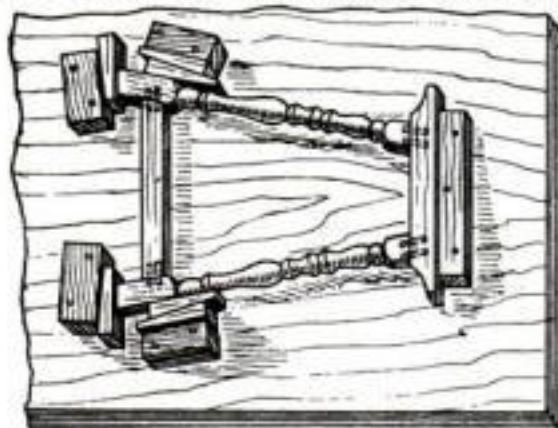
Assemble the gate from parts *G*, *H*, and *J*, again using the dowels dry. Insert the ½-in. dowel pins (on which the gate turns) into the top and bottom rails of the gate in the holes provided.

Now remove the top rail from the leg post assembly and place the gate in position with the metal washer between bottom rail *J* of the gate and the bottom rail *F* of the leg assembly. Observe that the notches in the gateposts *G* lap into two corresponding notches on opposite sides of top rail *E* of the leg assembly. Replace the top rail. Examine the assembly critically, first to see that all joints fit correctly, and second, to familiarize yourself with the construction so that you can proceed with the gluing without hesitation. Then disassemble the parts.

With joints as accurately made as these, the problem of gluing is a simple one. It is necessary, of course, to provide some means for clamping the parts together with moderate pressure. If cabinetmaker's bar clamps are available, they are the most convenient to use, but in their absence wedges may be quickly prepared to serve the same purpose as shown in the drawing at the left. Once a joint has been clamped, do not jar or disturb it in any way; this is most important. Apply glue in (Continued on page 119)



TOP OF BENCH SHOWING BLOCKS AND OUTLINE



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The Popular Science Monthly
381 - 4th Ave. New York

COFFEE TABLE IN MAPLE OR MAHOGANY

(Continued from page 118)

the dowel holes, on the dowels, and on both surfaces where two parts come together. If hot glue is used, work very quickly before glue has time to become chilled.

The first step in gluing is to assemble the gate. The easiest way to do this is to lay the gate parts in their correct position on the top of a bench (or any flat surface into which you do not mind driving nails). See that rails *H* and *J* are exactly parallel to each other and that posts *G* are both set at the same angle. Now trace around the assembled gate, drawing the outline on the bench. Remove the gate and nail a strip of scrap wood to the bench along the line which represents the bottom of gate rail *J*, as shown in the upper drawing. Nail other blocks in the positions indicated, keeping them slightly outside the penciled outline. Then saw out wedges which you can drive between the blocks and the gate members to press the joints together. When these are ready, apply glue to the joints, push them together, drop the frame into the improvised clamp, and drive the wedges into place until the joints have been squeezed tight and the shape of the gate coincides with the penciled outline.

NEXT glue the feet to their respective leg posts. Two clamps suitable for this purpose are shown at the bottom of the drawing. Be sure that the feet are placed correctly on the posts—that is, so the dowel holes where the lower rails join the posts are at right angles to the length of the feet. Allow the gate assembly and the two leg assemblies ample time to dry, according to the kind of glue used.

In the meantime, round off the top edges of the scalloped rails *B* with a half-round file and sandpaper. Mark the position of these rails on the top. Each should be centrally placed along the edge of the top and should rest against the inner projection of the molded edge of the top, which has been provided for this purpose. Since the screw holes are already drilled through the top, the rails can be fastened at once with screws and glue, and the top set aside for the glue to dry.

If the gate assembly is now dry, remove it from the clamps and glue one of the 1/2-in. dowels into each of the central dowel holes.

THE next operation is to assemble leg posts *C* and upper and lower rails *E* and *F*, at the same time placing the gate in position. It will be seen that three long clamps (of either type shown in the drawings) will be necessary—one to draw top rail *E* down against the end of one leg post, another to draw the other end of the top rail down on the other leg post, and a third to squeeze the two leg posts against the ends of lower rail *F*. Do not forget to place the washer between the gate and the lower rail of the leg assembly so as to provide the necessary clearance. Be sure the frame has no twist and is perfectly square. Use a try-square or a steel square to test it, or measure diagonally across inside the frame from left top to right bottom and from right top to left bottom. The two diagonal measurements should be exactly the same. If they are not, adjust the clamps until they do correspond.

When the glue is dry, round all sharp edges with a fine rasp or a file and No. 00 sandpaper. Emphasize the rounded effect slightly on the upper edges of the feet and the outer projection of the lower rail *J* of the gate.

Lay the top on the framework, center it accurately both ways, and mark on the underside of the top the position of the top rail *E*. Note where the recesses for the hinges have been cut in (Continued on page 120)

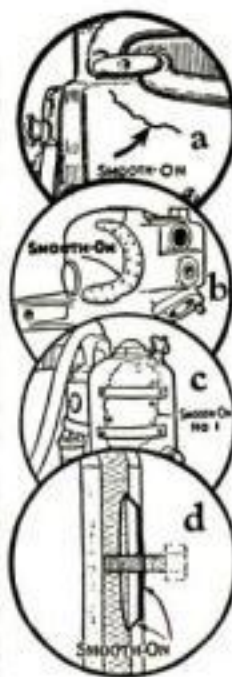


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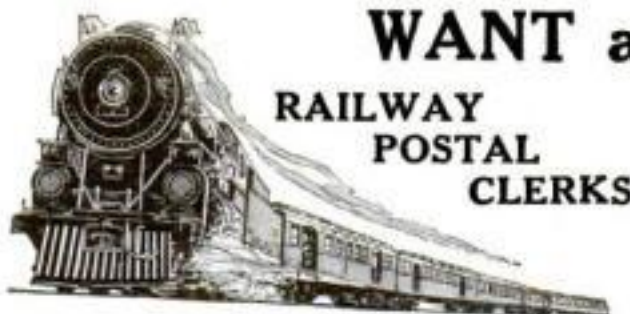
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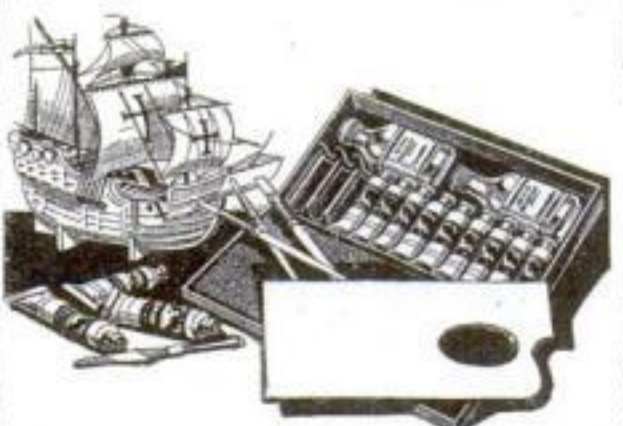
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COFFEE TABLE IN MAPLE OR MAHOGANY

(Continued from page 119)

the top of this rail and mark the underside of the top to correspond. Screw one leaf of each hinge to the underside of the top in the marked position (see the photograph in middle of page 79); then set the other leaf of each hinge in the recess provided in the rail and drive the screws.

Swing the gate open so that it stands exactly at right angles to the top rail and

OUR THREE KITS

Three tables that can be built from the Guild construction kits now ready. Refer to the text below for sizes and description



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KIT NO. 2



KIT NO. 3

mark the position of the gate stops on the underside of the top. Saw in two the block K provided for the stops and taper each stop slightly so that it will be wedgelike in appearance. Glue the stops in place.

Remove any surplus glue, and smooth the surfaces with No. 00 sandpaper where necessary. Then apply the finishing materials as directed on the label of each can.

To order one of the coffee table kits, fill in the coupon below and check Kit No. 3 for maple or No. 3A for mahogany.

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PEDIGREED RATS KEY TO HEALTH

(Continued from page 42)

infectious diseases. Especially valuable as sources of this necessary ingredient in a balanced diet, I learned, are oranges, lemons, tomatoes, raw cabbage, turnips, onions, apples, bananas, carrots, pineapples, spinach, and string beans.

Not long ago, the rats in the Home Economics laboratory revealed an interesting new source of vitamin C. By allowing dried beans and peas to sprout, the foodstuffs in them are changed to other substances rich in the desired element. The cooked sprouts are said to make a wholesome and palatable dish. When tried out by means of the living test tubes in the laboratory, they were shown to be a valuable source of the anti-scurvy vitamin.

When I visited Dr. Munsel's laboratory, I found the white rats being served water-melon. Tests were being made to find out what vitamins it contained. The results later showed that the melons are a good source of vitamins A and C, and that they contain small but detectable amounts of B and of G.

THE menu prepared for the rats, each food being served to a different group of test animals, included at the time such a wide variety as olives, honey, pork chops, yeast, liver, apples, and grape juice. Incidentally, it was discovered that honey contains no vitamins.

Some sixty of the white rats were just beginning to take an interest in their surroundings. After being deprived of vitamin A for several weeks, they had had Thompson's seedless grapes added to their daily rations. The fact that they were flourishing proved for the first time the existence of vitamin A in this fruit.

A method for supplying this vitamin in a concentrated crystalline form is proposed by two scientists of Oberlin College, Ohio, Dr. Henry N. Holmes and Dr. Henry M. Leicester. At a meeting of the American Chemical Society, they recently reported a new process for extracting carotin, the vegetable pigment which the three British chemists have just proved contains the long-sought basic material of vitamin A. By means of their process, they say, carotin can be extracted from carrots rapidly and at a comparatively low cost.

Supplementing this announcement was another made before the same scientific body by Dr. R. G. Turner of the Detroit College of Medicine and Surgery. If you don't like spinach, he says, you soon will be able to get your essential vitamins by swallowing a pill or taking a "shot in the arm" with a hypodermic needle. He has carried on a long series of tests in injecting various vitamins in concentrated form into laboratory animals and has found the results to be uniformly satisfactory.

TAKING two groups of rats suffering from lack of vitamin A, he fed one food containing the missing element and gave injections of the needed vitamin to the other group while continuing the rations the same as before. The rats getting their vitamins by injection gained in health just as rapidly as did those that obtained theirs in the ordinary manner.

While making one of his meat tests, Hoagland discovered a concentrated form of vitamin G in an unexpected quarter, he told me. After trying out experimental animals on various cuts and types of beef, he gave them beef extract. Previously, it was thought that the extract contained little if any of this vitamin. Yet, the testimony of its effect upon the rats showed that it was unusually rich in this pellagra-combating element.

In fact, the scientist informed me, one pound of concentrated beef extract contained approximately the same amount of vitamin G as *eleven pounds* of fresh, lean beef!

A few years ago, during tests upon dried meat, Hoagland stumbled upon a mystery that remains unsolved to this day. Groups of rats were being fed rations of dried lamb to determine its vitamin A content. Each group had its meat diet prepared from a different source; that is, meat from sample Number 991 would be given to one batch of rats, meat from sample Number 992 to another batch, and so on.

The results were anything but uniform. The animals fed on the dried lamb Number 876, for instance, failed to develop, declined in weight, and six out of the eight died. Similarly, those fed on lamb Number 897 all developed a disease resulting from a deficiency in vitamin A in twenty-two days or less, although as much as thirty percent of the dried meat was included in their daily rations.

THE groups given sample Number 992 and 994, however, showed immediate beneficial effects of the treatment. When no more than twenty percent of the dried meat was added to their diet, they showed remarkable development and continued to grow and gain weight until the experiment was discontinued at the end of ninety days. Why had one sample of dried lamb contained little or no vitamin A and another been rich in this necessary element?

In an attempt to find the answer, Hoagland traced the samples, which had contained the concentrated vitamin A. He found that they both had been purchased at the same time from a local meat-packing establishment. Further inquiry revealed that the two lamb carcasses came from a carload of animals purchased in Chicago and slaughtered at Benning, D. C. Here the trail ended, so it was impossible to discover what the two lambs had been fed and the curious mystery of their vitamin-filled bodies remains unsolved.

After every experiment in the vitamin-hunting laboratories, the "test tubes" are discarded. None of the experimental animals is employed in more than one test, because the effects of the period of vitamin deficiency, which is part of every research, are likely to leave a permanent mark upon the vitality of the tested animal. It is only by using carefully selected specimens of the same age and state of health that experimenters are able to carry on their studies in the strange and important realm of vitamins.

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TRIANGULAR instead of round in cross section, a new "streamlined" auto tire has appeared on the market. It runs on only twelve pounds' air pressure, or about one third of that used in ordinary balloon tires, but the triangle design insures a tread no wider than in standard tires.

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A COLLEGE ON WHEELS FOR FIREMEN

(Continued from page 25)

go there to a big stable fire. We'd want to bring the horses out—and this mask might be the means of saving Twenty Grand or some other fine horse."

"Masks are being added to the equipment of volunteer fire fighters all over the country," Chief Murray said. "I carry one of the latest models in my car. Even the small villages of America contain a hazard for firemen to which few persons have given much thought. It is mechanical refrigeration. As a matter of fact I give an extensive lecture on this hazard as a part of my college course."

LIKE most city dwellers I had supposed that volunteer firemen were an almost extinct species. Chief Murray set me right on that.

"About fifty-five percent of the population of this country," he said, "are protected from fires by paid firemen. The rest of the population depends on volunteer fire fighters or else have no protection. Probably twenty percent get good protection from these voluntary organizations. Reading, Pa., with a population of over 110,000, is the largest city with a fire department of volunteers. Only lately was it decided there to establish a paid fire department. If you suppose volunteer firemen still operate as bucket brigades and with hand pumps, you are behind the times."

"This outfit I'm training now has better apparatus in some respects than some big cities have in their outlying sections. None of them are in a hurry to scrap their fire fighting machines. Consequently many of the paid firemen of the big departments, especially those in the suburbs, ride to fires on apparatus not nearly so modern as that of some of the volunteer companies."

Not only the tools but the personnel of volunteer organizations is vastly improved nowadays. Many of Chief Murray's pupils are thoroughly capable of absorbing all of the science he can fling at their heads. One of his classes, for example, included a Yale professor of mathematics. Commonly his classes contain college graduates as well as men who can neither read nor write.

THE Rev. Dr. Joseph Allen, of Sea Cliff, L. I., an enthusiastic booster for Chief Murray because of his interest in fire fighting, is president of the New York State Firemen's Association. He was largely responsible for a recent application of Murray's scheme of training on a permanent basis in Nassau County. During 1932 that county will establish a traveling drill school and fire college for all of the fire fighters of the county.

"That looks like competition," I said to the chief.

"Competition?" He echoed the word scornfully. "It is an idea I try to put across everywhere I go. There are more than 3,000 counties in the United States, and most of them would be better off if they employed a competent man to give the kind of training I am giving. There is a matter of knots. It is foolhardy for the firemen of neighboring villages to use different kinds of knots in tying ladders together. Whenever two departments are called on to work together they waste time. Time wasted at fires means wasted property and as sometimes happens, wasted lives."

"This is so important that it is the subject of the first lesson I give in my fire school. There are knots for putting a line on an axe or a pike pole. The proper way is to use two half hitches, or clove hitch, on the bottom of the handle, then a half hitch on top and tie tightly before it is hauled to a roof or lowered. Now suppose the man on the ground fastens an axe to a line with a knot which is not understood by the man

on the roof who is in perilous need of that axe? You see? Well, there are knots for tying ladders; knots for the line put on a hose when it has to be hauled over a roof; there is a rolling hitch for holding a hose on a roof; and then there is the rescue hitch. Then there is ventilation."

"Proper ventilation is one of the fundamentals of fire fighting. About three quarters of all fires start below the street level of buildings, but a fire chief who knows his business will send men to the roof just as promptly as he sends men into the cellar."

CHIEF MURRAY made one thing clear to me about this strange enthusiasm which impels men to make fire fighting a hobby. The same man who, in the cities, is known as a fire bug is usually an energetic member of the volunteer fire department.

The fire bug is the raw material from which volunteers are made. Often when Chief Murray starts on one of his long distance runs to a fire he finds trailing in the wake of his scarlet eight-cylinder automobile some of these folks who can't resist the impulse to go to a fire. Sometimes they get a longer ride than they expect, for Frank Murray has gone frequently forty, fifty, and sixty miles in order to get to a fire with which a class of his pupils was struggling.

IT WAS a sixty-mile run to the scene of a summer resort fire a couple of years ago. The hotel, a wooden structure, was closed for the winter. It was surrounded by a colony of cottages, and when the first alarm sounded the volunteers of the community telephoned word to Chief Murray. He was sixty miles away, but in just about half a minute he was rolling. He made the run in a trifle more than an hour.

"They were in trouble when I got there," the chief told me. "A high wind was whipping the fire into the frame cottages and these were like tinder. The blaze was spreading fast. I found them operating small fire streams, and this was a fire that called for all the force they could bring to bear. I had them change their inch nozzles to inch and a half, and then we proceeded to battle with three large streams. We lashed the hose, near the nozzles, to the rail pipes of the hose wagons which we backed up to vantage points in front of the fire. In two hours we stopped the spread of the fire, saving two solid blocks of cottages as a result."

There are hazards linked with the use of high powered fire fighting tools that stress the need for training. Frequently inexperienced men are thrown and fatally injured by the back pressure that modern pumps exert on a hose line.

"I've seen plenty of men," he said, "get their legs broken or their skulls fractured by trying to handle a hose line carrying too much pressure to be controlled by the arms of even the strongest men. Somewhat different from fighting fire with bucket brigades, eh?"

It is different, and the father of volunteer fire fighting in America, Benjamin Franklin, would open his eyes wide if he could see the developments that have followed in the wake of that civic enterprise which he began in 1736 with the organization of the Union of Philadelphia. Franklin was a member of the Union company of Volunteers. In those early days and for long years afterward, there was no such thing as fire insurance, and volunteer firemen not only extinguished fires but commonly turned to and raised a new house on the site of the one that was destroyed. Some companies went farther than this, giving clothing and furniture to replace that which had been burned.

KEEP YOUR PATENT OUT OF TROUBLE

(Continued from page 53)

the invention, was entirely unnecessary.

Patent law is highly technical. You have to live up to all its rules. But inside these rules there is considerable latitude. For example, you must show that your invention has some use, but you don't have to show that it is very useful, or even more useful than a similar device already on the market. However, somewhere, be sure to:

Indicate some utility for your idea in your patent application.

In every application there are twin dangers that must be avoided. They are: claiming too much and claiming too little. Frequently, the man who tries to cover too much ground in his patent and get more than he is entitled to ends by getting nothing. The broader the claims made, the greater the danger that someone will uncover a prior patent or published report that anticipates the idea.

For many years after wire ropes first appeared, there was considerable trouble with twisting and tangling. Then an inventor, after hundreds of experiments, overcame the difficulty by incorporating two layers of strands in the rope, one turning one way, the other the other, with different "lays" or rates of twist. He found that when one layer made one complete revolution to the other layer's 1.87 revolutions, the result was a wire rope that did not twist or tangle. He patented his process, limiting his claims to the 1 to 1.87 ratio instead of trying to cover all ratios in a broad, inclusive patent.

THE wisdom of this appeared a little later. Another manufacturer put a rope having a 1 to 1.8 ratio on the market. He sued him for infringement and the courts upheld him, although in the meantime a prior German patent had been discovered which indicated the reversing twist process with the lays having a ratio of 1 to 2. Had the inventor's patent covered all ratios, the finding of the prior 1-to-2 process would have resulted in the loss of all his claims. So, rule number six is:

Avoid making your claims too broad.

On the other hand, too narrow claims have lost millions of dollars for inventors. The problem is to steer a course between the two.

Not long ago, the owner of a patent on an electrically controlled pneumatic cash carrier sought to collect damages from a rival manufacturer for infringement. In court, it was shown that the patent so described the mechanism that a certain valve was necessary to make the apparatus work. When the defendant proved he did not use such a valve, although every other feature of the invention was copied, he was awarded the decision. By making his claims too narrow, the inventor had obtained a patent that was almost worthless.

CONSIDER another case. When Emile Berliner, the inventor of the microphone, worked out a valuable new method for making phonograph records, his application was amended in the Patent Office, limiting the claims to records made of hard rubber. This was done to avoid conflict with prior patents cited by the examiner so protection could be obtained as quickly as possible.

In a later infringement suit, a defendant proved his records were made of shellac, earthy material, and lampblack and, although he had copied every other detail of Berliner's process, the court found the inventor could collect no damages. By limiting his claims to hard rubber instead of "hard rubber and any equivalent material," he lost much of the protection he (Continued on page 124)

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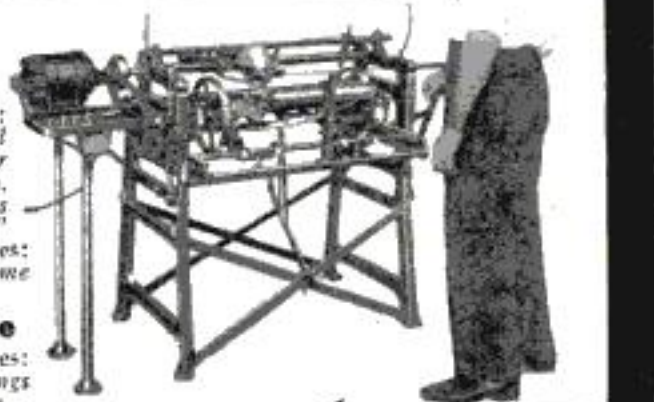
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| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Chemistry <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Patternmaker <input type="checkbox"/> Machinist | <input type="checkbox"/> Coal Mining Engineer |
| <input type="checkbox"/> Reading Shop Blueprints | <input type="checkbox"/> Navigation |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Agriculture |
| <input type="checkbox"/> Highway Engineering | <input type="checkbox"/> Textile Overseer or Supt. |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Cotton Manufacturing |
| <input type="checkbox"/> Gas Engines <input type="checkbox"/> Toolmaker | <input type="checkbox"/> Woolen Manufacturing |
| <input type="checkbox"/> Diesel Engines | <input type="checkbox"/> Fruit Growing <input type="checkbox"/> Radio |
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| <input type="checkbox"/> Accountancy | <input type="checkbox"/> English <input type="checkbox"/> Signs |
| <input type="checkbox"/> Cost Accountant | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> C. P. Accountant | <input type="checkbox"/> Railway Mail Clerk |
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| <input type="checkbox"/> Secretarial Work | <input type="checkbox"/> Grade School Subjects |
| <input type="checkbox"/> Spanish <input type="checkbox"/> French | <input type="checkbox"/> High School Subjects |
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| <input type="checkbox"/> Advertising | <input type="checkbox"/> Lumber Dealer |

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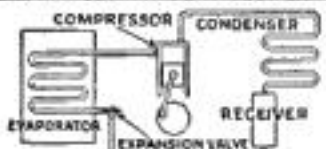
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KEEP YOUR PATENT OUT OF TROUBLE

(Continued from page 123)

might have had and to which he was entitled.

Trying to rush a patent through is the most frequent cause of trouble of this kind. Annoyances and delays in the Patent Office, great as they are, are trivial compared to losing a fortune later on. The attorney handling your invention should be encouraged to check up on all prior and conflicting patents cited by examiners instead of immediately narrowing down the claims to get around them.

Only the other day, I looked up such a citation and found that the previous invention which had been patented wouldn't work! It was taken out on a cash register in which the apparatus was supposed to add, subtract, and multiply. When it added, a moving curved surface was supposed to drive a rod to do the adding as though the surface were a true circle, but, when it multiplied, the same surface was supposed to act as though it were a helix or part of a spiral. The helix and circle were near enough together so the register operated correctly for amounts between eight cents and \$1.40. But for all other numbers there would be an error!

THAT patent had been out for nearly ten years. It had been cited almost a hundred times by the examiners, yet nobody had looked it up and analyzed it before, and scores of people had failed to get patents on adding and multiplying machines to which they were entitled.

On a number of other occasions, I discovered that the examiner had cited a patent on a device that would not work. Sometimes models have been built to demonstrate this fact to the judge or jury in court.

Clients who rush their attorneys instead of letting them look up all prior patents cited against applications are penny-wise and pound-foolish. The cost of looking for flaws in such citations, instead of immediately narrowing down the claims, usually runs between ten and twenty-five dollars. This small investment may save thousands later on.

The best method I have found for satisfying both exactness and broadness in an application is to write a little essay at the beginning describing the "art," or branch of industry, to which the invention belongs and then follow it with a very minute description of the best form of the invention actually used, with the statement that "the invention is herein illustrated as embodied in that form."

This procedure lays the basis for any kind of claims or definitions needed to protect the invention properly. If your attorney follows this plan, it will save later difficulties in many instances. Also, encourage him to check up on prior patents cited against your application. This will give you a solid basis that will enable you, in the final wording of the application, to:

Avoid making your claims too narrow.

ANOTHER reason why your patent attorney should study carefully the prior citation is that there may be some error in a drawing that will disqualify it. Incidentally, be sure to check over your own application drawings several times before they go to the Patent Office. Even the slightest slip may have serious consequences.

One such error, I recall, could have been corrected in two minutes at the time the drawing was made, but to alter it later cost thousands of dollars and required eight years of litigation that finally reached the Court of Appeals in the District of Columbia. In finishing the drawings of a glass-making machine, the draftsman inked in two small

pencil lines by mistake, thus making a shaft extend across the path of the glass. Nobody noticed it for years and the patent went into court several times before the error was seen. After a terrific court fight, the inventor was allowed to correct his patent, but, in many other cases, patents with slightly greater mistakes have been held void and uncorrectable.

Check over your drawings to be sure they contain no errors.

Although the Patent Office does not require a model of your invention, such a miniature reproduction frequently aids in getting the drawings right. For another reason, it pays to build a working model, if not before, at least as soon after filing your papers as possible. It indicates that you are going ahead with your invention.

OFTEN the fact that an invention is actually in commercial use while the patent application is pending can be employed to persuade the examiner or the court after the patent issues, that the invention is of real value and worthy of a broad patent. One such case occurred a few years ago. An idea for a street car transfer with a detachable "P.M. coupon" was put through the Patent Office by an inventor. The coupon was perforated so it could be torn off by the conductor during the morning hours and left on in the afternoon.

Although a ticket book and a menu card, with similar detachable features, had been held unpatentable, the inventor of the coupon transfer was awarded protection when he sued an infringer. One of the main reasons for this decision by the court was that the transfer was already in use on forty-four railways, operating in nineteen states. It had demonstrated its value and had proved it was a needed invention and not merely a "paper patent." Thus, rule number nine is:

Take active steps to show that yours is not a "paper patent."

One more suggestion. If you take out two patents on inventions closely related, be careful to keep them independent. Don't let one kill the other. An example will illustrate what I mean.

RECENTLY, the patent on a wire-bound carton expired. The courts held that a second patent, which had been taken out on a machine for making the boxes, was also void, although it had been issued ten years after the first one. The case went to the Supreme Court. This tribunal ruled that when the patent on the box, which necessarily explained exactly how to make it, expired, the explanation gave to the public all that could be patented in connection with the process of manufacturing it. Probably the trouble lay in the faulty wording of the application for the machine patent. It described the operation of the mechanism solely in terms of the patented box. If it had described the mechanism as performing a certain kind of operation, instead of tying it up so closely with the object of the first patent, the difficulty very likely could have been avoided and the expiration of the first would have left the second patent unaffected. Remember:

If you get two patents on related inventions, word the applications so one does not "lean" upon the other.

Delays and annoyances in patent-getting probably will continue as long as the law remains so highly technical and the Patent Office so far in arrears with its work. But, if the ten simple suggestions noted in this article are followed, they will do much to keep your patent out of trouble.

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A definite program for getting ahead financially will be found on page four of this issue

HIGHWAYS FOR YOUR MILE-A-MINUTE CAR

(Continued from page 39)

grades. They now realize that many other qualities are necessary. New York's Bronx River Parkway Extension, mentioned at the beginning of this article, is wide and smooth, of course, and free from sharp turns. Most important, however, are the features built into it to ensure speed with safety through traffic control.

For example, it is so laid out that wherever other large arteries cross it, they do so over bridges. Drivers who wish to leave or enter it can do so only at specified points, by means of service roads, clearly marked and with unobstructed visibility. Designed with an eye to beauty as well as maximum usefulness, it is permanently protected, by a wide right of way, from the possibility of blight by encroaching billboards, hot dog stands, and gas stations. For these reasons it is recognized all over the country as a model of modern motorway planning.

Because of expense, geographical obstacles and other limitations, it is impossible in every case to produce a highway so nearly ideal. It is too much to expect that all the trunk roads of the United States will be revolutionized within the next ten years. But the parkways of New York, the super-highways of Michigan and New Jersey, the "by-pass" projects in Boston, Pittsburgh, and other cities, are indicative of the modern trend.

ONE of the basic principles of the new technique of highway design is that express and local cars must be prevented from mixing. The obvious method of keeping them separate is to relocate through routes in order to by-pass, or skirt, towns and cities. Since it is not always practicable to do this, other means are being developed to accommodate the two classes of traffic on the same right of way, but separated by raised strips that divide it into lanes.

In Boston plans are under way to build an elevated express highway to speed transient traffic through the city. Such a structure already exists in downtown Manhattan and is now being extended. It enables the motorist who is in a hurry to drive at thirty-five miles an hour, independent of stop lights and the cross streets below.

Both in approaches to cities and in the open country it has been found that the intersection is the greatest single source of danger and delay. The ideal method of treating an arterial intersection is by means of a grade separation, or bridge. Several of these, with ramps of the clover-leaf design, which eliminate all left-hand turns, have been put into successful operation in Chicago, in Michigan, New Jersey and elsewhere.

TRAFFIC counts made before and after such installations show that grade separations almost double the capacity of crossings, while eliminating delays and accidents. Their use, however, is greatly limited because of their cost, which may run from \$100,000 to \$200,000 and even more.

Least expensive of all express highway safety devices is the full stop sign. Unfortunately it is also the least effective, because a peculiarity of many drivers is that while they will stop for a red light, they will ignore a sign. To overcome this dangerous human foible, traffic engineers have evolved several plans.

One is to widen the junction points on main highways, so as to provide an extra entering lane. Another is to prevent right angled crossing of the traffic stream by placing raised strips along the center line of the express way. These force the motorist wishing to cross to enter in the (Continued on page 126)

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HIGHWAYS FOR SPEED

(Continued from page 125)

direction of the moving cars. He then weaves gradually over to the center strip, hugging it until he reaches a gap permitting a left turn, where he enters the stream coming from the other direction. He weaves across this and comes out onto a side road opposite the one by which he entered.

A scheme similar to this is being built into the new Mt. Vernon Memorial Highway, running from Washington to Mt. Vernon, now under construction by the U. S. Bureau of Public Roads.

The known fact that ninety percent of all motor accidents are caused by failure of the human factor emphasizes the importance of making highways driver-proof, insofar as may be possible. The habits of drivers have a direct bearing on road design.

In a survey made by the U. S. Bureau of Public Roads, cooperation with local authorities in the Cleveland regional area, an interesting discovery was made illustrating this point. Most drivers, they found, dread pavement edges. On roads eighteen feet wide, the average distance between passing cars was only one foot, the drivers preferring to sacrifice clearance rather than approach the outside edges. Increasing the width of a highway, they discovered, without marking definite lanes on it, merely allowed drivers to indulge their tendency to seek the middle of the road.

ON THIRTY-TWO, thirty-eight and forty-foot highways, the average distance of rear wheels from the outer edges was over eight feet. Among the conclusions based on this survey was that any width greater than twenty feet and less than forty feet is uneconomical, because the added width between those dimensions adds little to the capacity of the highway.

Segregating various classes of traffic in lanes, according to their speeds, is a practice that will be used increasingly wherever sufficient highway width is available. We may look forward, in the not far distant future, to multiple-laned motorways, on portions of which speeds up to and possibly exceeding a mile a minute will be permissible. Because drivers will not drive fast near curbs, walls, or other fixed objects, or near pavement edges, the high-speed lanes will require very carefully studied treatment.

Robert A. Whitten, noted city planning consultant, now engaged in helping to solve the Boston traffic problem, has made interesting suggestions along this line. He suggests either raised, or depressed, roadways for swift-moving cars, separated from the slower-vehicle lanes by turfed and planted embankments. The theory is that placing the two classes of cars on different levels will reduce confusion and nerve strain for the drivers. And the turf and planting will tend to absorb noise.

EVERY detail of highway improvement should be based on knowledge of the facts. Knowing that motorists will not drive near fixed objects, road shoulders should be made so wide that guard rails, signposts, and the like will not contribute to the tendency of traffic to swing toward the center. Knowing that many drivers habitually cut corners, we should restrain them automatically by installing raised channelizing islands in the throats of intersections. By separating traffic streams moving in opposite directions by medial stripes, we can prevent drivers from crossing center lines, thus preventing head-on collisions due to carelessness or to head-light glare.

Increased speeds require greater visibility, not only of the highway ahead, especially at curves and intersections, but as regards traffic

lights and signs. The latter must not only be visible, but explicit. High speeds also require that the motorist be given more time than formerly in which to obey signals and signs. The correct placing of these devices depends on studies of average car speeds and braking distances at the points where they are to be installed.

For some years uniformity of signs and signals has been urged by the National Conference on Street and Highway Safety, the National Safety Council and other interested organizations. Much confusion results from the present lack of such uniformity, a condition arising from the fact that, in most states, individual communities have the power to select their own regulatory equipment and make their own speed and traffic regulations. A standardization of principles and practices is needed.

Speed and safety are by no means the only factors to be considered in planning the modern motorway. The item of attractiveness is important also. In much, if not most, of our highway construction so far, it has been grossly neglected. One of our national characteristics has been to ignore beauty, to scoff at it even, unless we could be shown that it would pay dividends in dollars and cents.

FAILURE to foresee that the preservation and development of roadside beauty would yield a tangible return has cost us dearly. We have thousands of miles of highways flanked by raw earth embankments, billboards, automobile dumps, conglomerations of dog stands and gas stations, all of which are eyesores and all of which depress property values. This uncontrolled roadside deterioration has ruined hundreds of formerly desirable localities in towns and cities and in the open country.

Profiting by past mistakes, far-seeing highway authorities are taking steps to forestall future roadside blight. Michigan, for example, is buying rights of way 800 feet wide for projected motor routes through her forests, in order to protect them from encroachment, neglect and decay.

Highway departments in California, Connecticut, Vermont, Maine, Massachusetts and a few other states have waked up to the situation and are actively working for highway beautification. This includes tree planting, tree surgery, the covering of embankments, the control of billboards and the opening of scenic vistas by scientific forestry and landscaping methods.

THE Mt. Vernon Memorial Highway, already mentioned, has a minimum right of way of 200 feet, except through the city of Alexandria, Va. "Special attention," says the report of the Bureau of Public Roads, "has been given to the development of interesting alignment, and the long, easy curves, fitted to the natural contours of the land, are outstanding features of the design.

With the aid of a landscaping scheme, which has been carefully studied, the road will appear, when completed, as a natural part of the countryside. The scars of construction, which detract from the pleasure of driving over many new roads, will be carefully obliterated on this highway."

Though the purchase of wide rights of way and the extensive landscaping of road-sides may seem expensive, their economic justification is being amply proved. Since the first link of New York's Bronx River Parkway was opened, in 1923, values in the territory it traverses have increased from 100 to 800 percent annually. The recent opening of its extension is expected similarly to increase values all along its route.

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MEASURING THE U. S.

(Continued from page 23)

long ago decided to have a comprehensive standardized survey made of the entire country. To the Coast and Geodetic Survey fell this herculean task. It was started more than one hundred years ago and is not finished yet. So slow and cumbersome were methods and apparatus for surveying many years after the work was started and so meager the allotted funds that the survey fell sadly behind the development of the country.

The great work, however, gathered speed as the years rolled by. New methods and appliances, mostly developed by Coast and Geodetic Survey engineers in their own workshop at Washington, and greater appropriations are responsible for this acceleration. As late as 1900 a triangulation party could establish not more than fifteen stations in the course of a season's work. At present a single field party can establish one hundred or more stations in that length of time.

TRIANGULATION is the yardstick by which vast areas of ground are measured by engineers. It makes use of a principle that is well known. If the length of one side of a triangle and the values of two of its angles are known, the third angle and the lengths of the other two sides can be accurately computed.

The work of triangulation of a country is done in bands, each composed of many hundreds of comparatively small triangles. In starting such a band, a base line of known length is laid out on the ground. By the most careful astronomical observations the latitude and longitude of one end of the line is established. Further astronomical observations determine the direction in which the line extends with reference to true north.

This line is the starting point for a band of triangles that may extend clear across the continent. A few years ago a large party of men was required to establish a base line, which was measured off by means of a cumbersome metal bar. Today base lines are measured by tapes made of invar metal. This material is less affected by contraction and expansion caused by atmospheric changes than any other metal available. Each invar tape is measured for atmospheric expansion and contraction at the United States Bureau of Standards before and after it is taken into the field by a working party. Invar base tapes are usually about fifty meters in length, and the probable error in such tapes is said to be less than one part in 300,000.

FROM each end of the base line, angles are laid off by means of theodolites sighted on convenient distant landmarks. In the days of slow surveying this work was done in the daytime. Transits then in use were sighted on targets stationed on the distant points. Such targets usually were a combination of mirrors arranged to focus sunlight into a spot of light that could be seen for considerable distances. Thus triangulation could only be carried out on bright days.

Today triangulation is done at night. Targets at which the engineers sight their theodolites are powerful electric lamps established on sighting points ten or fifteen miles away. Theodolites used in this work are refined transits, electrically lighted, so that by means of micrometer microscopes their circles can be read in the darkness.

In flat country where a long view across the land cannot be obtained triangulation parties erect towers, often more than one hundred feet in height, on which their instruments are mounted. One party will employ as many as ten or twelve towers at one time. Formerly such (Continued on page 128)

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"I suppose I'd be worrying myself sick right now, just as you are doing, if I hadn't happened to get hold of a booklet written by Arthur R. Patterson. Patterson was a Secretary Examiner of the Civil Service Commission for eight years. It was through the help he gave me that I got such a high rating and got my government job so quickly.

"If you are 'shaky' about your job and wondering what's going to happen to you, I suggest, Bill, that you write to Arthur R. Patterson in Rochester right now for a copy of his booklet.

"Well, so long, Bill, we pull out of here in a couple of minutes and I have to get going."

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MEASURING THE UNITED STATES

(Continued from page 127)

towers were permanent wooden structures, requiring a great deal of time and labor to build. Light temporary steel structures are used for this purpose today. These towers can be erected to heights of more than one hundred feet in less than one working day, and when they have served their purpose they are taken down and moved with the party to the next station.

The motor car has played an important part in speeding up surveying work. Before 1909, horses were used for the transport of field parties and their equipment. Since stations were often as much as fifty miles apart, this meant a great loss of time. Now, however, field parties are carried swiftly from one station to the next in motor trucks.

Coast and Geodetic Survey engineers, in running bands of triangulation, do not work from one end of a line to another. Doing so might result in an accumulation of unavoidable errors. So they start their bands as loops, or work from both ends or the middle of a line. Thus in closing loops or lines, many errors are eliminated.

THE work of surveying this country is now being carried out from the geographical center of the United States, which is a spot called Meade's Ranch, just outside of Lucas, Kansas. This point is also used as a reference mark by both the Canadian and Mexican governments in their own surveys, tying into the work of the Coast and Geodetic Survey. Thus when the great task of surveying the entire North American continent is finished, it will be more nearly accurate than the survey of any other continent, since all surveys are worked from a common point of reference.

At present more than 30,000 miles of triangulation bands have been completed. At frequent intervals along the line of this work, engineers of the Coast and Geodetic Survey have left little concrete monuments. Inserted in the top of each is a brass disk on which are engraved the initials of the Coast and Geodetic Survey and information about that station of value to surveyors who may have to tie into it for local work.

Too-ardent treasure seekers, Major Bowie told me, caused the Coast and Geodetic Survey to adopt this style of survey marker. Before they were adopted, triangulation stations were simply a few figures cut in some convenient rock or block of concrete. Curious persons, finding such figures in wild or sparsely settled country, generally thought they had some reference to treasure buried in the immediate neighborhood. As a result, they often dug up the near-by ground, destroying the station and putting the Government to great expense in reestablishing it.

THE accuracy of Coast and Geodetic Survey instruments and methods were a great aid to the late Professor A. A. Michelson when he conducted his experiments on the speed of light. In the first experiment it was planned to time the speed of a light ray passing between two mountain peaks in California. Obviously the success of this experiment depended on knowing as accurately as possible the distance between the peaks. Coast and Geodetic Survey engineers determined this distance to be twenty-two miles, with a probably error of not more than one or two tenths of a foot!

Establishing sea level and carrying it inland for the benefit of the construction engineer is another part of the work of the Coast and Geodetic Survey now being carried out along with the great triangulation plan.

At forty-seven points along our Atlantic and Pacific coasts they have established tidal stations, with secondary stations at 3,520

other points. Instruments in these stations make hourly records of the rise and fall of tides throughout the day. Each station is built out in the water on top of a group of piles or alongside a pier. In a small hut erected over the station are the instruments, while on a vertical staff beside the piling the apparent height of the tide can be read at any time in feet and tenths of feet.

Near the seashore, at a point adjacent to each tidal station, there is usually to be found a small monument similar to a triangulation station. The top of this monument is at a known distance above mean sea level as referred to the near-by tidal station. From monuments such as these, Coast and Geodetic Survey engineers have carried sea level inland, over about 60,000 miles of lines. Dotted along these lines are about 30,000 of the little level monuments such as we saw near the water's edge. Like the triangulation stations these monuments are engraved with identification data of the Coast and Geodetic Survey and are known as bench marks.

IN MANY parts of the country today the magnetic needle is still employed in retracing the old boundary lines, which had been laid out by compass, and in the cheaper kinds of surveying, just as it was in George Washington's time. As every schoolboy knows, the magnetic needle is actuated by the earth's magnetism and does not point to the true North Pole. Consequently its needle always makes an angle, called declination, between true north and the direction in which it points. Since magnetism varies in all parts of the country, this angle varies widely according to the locality in which it is used. Measuring the true direction of the needle and the magnitude of magnetic forces has become an important part of the work that is accomplished by the Coast and Geodetic Survey engineers.

For the past twenty-five years they have been engaged, in collaboration with the Carnegie Institution, in an extensive magnetic survey of the Western Hemisphere. Five magnetic observatories have been erected—one at Sitka, Alaska; another at Honolulu, T. H.; a third at Cheltenham, Md.; a fourth at Tucson, Ariz.; and a fifth at San Juan, P. R.

Delicate instruments at these observatories make photographic record of changes in the earth's magnetism.

In addition once each week optical observation of these changes are made. The apparatus used for recording these delicate variations is known as a magnetograph. It is really a set of four instruments, three of which are variometers—one for recording the earth's declination, one for recording the vertical force of the earth's magnetism, or dip; and one for measuring the total intensity of the magnetic force in the earth. The fourth instrument is the photographic recording apparatus.

THE result of this work has been the placing at nearly every county seat in the United States—nearly 4,000 stations—of a mark showing the earth's magnetism for that locality. These marks are in almost daily use by surveyors all over the country. But our amazing civilization is changing the earth's magnetism in cities such as those in which many county seats are located. Steel buildings, street railway tracks, and even automobile dumps are responsible for such changes. So Coast and Geodetic Survey magnetic stations are being moved out into the country to the nearest triangulation station unaffected by local magnetic disturbances.

(Continued on page 129)

MEASURING THE U. S.

(Continued from page 128)

At various scattered points throughout the United States the Coast and Geodetic Survey has established longitude and latitude stations. These, in connection with other stations for the measurement of gravity within the borders of continental United States, are used in the broader work of large scale surveying for what is known as figure of earth work; that is, the shape of that portion of the globe belonging to Uncle Sam. Most of us think of the world as a globe, slightly flattened at the poles. But the specialists of the Coast and Geodetic Survey know it is flattened so much that degrees of latitude get considerably longer as we go farther north.

Let us see how this vast accumulation of data, including vertical and horizontal measurements of the surface of the United States and physical properties of the ground beneath our feet, is used by engineers. A vast bridge springs across more than 1,000 feet of open water in one giant stride. From two towers on opposite sides of the bay or stream its steel spans are built outward until they meet in mid-air. Every rivet hole in each girder and bracket is drilled in fabricating shops perhaps thousands of miles away. Yet when the last connecting truss is dropped in place between the outstretched arms of thousands of tons of steel, rivet holes match with beautiful precision.

A TUNNEL is being cut, let us say, through a range of the Alleghenies. On one slope of the range a working party starts boring into the mountain; miles away another party is at work on the opposite slope. Apparently each party is working independently of the other, yet eventually they meet deep within the mountains.

Had the distance between the bridge piers not been known, and had their heights not have been determined from a common system of levels, the structure could not have been built. Had the tunnel builders not worked on similar systems of levels and triangulations, directing their borings from data supplied by standard reference marks like Coast and Geodetic Survey triangulation stations and bench marks, their two cuttings would never have met.

When the Coast and Geodetic Survey's great task is finished there will be no point in the entire country, from Maine to California, more than twenty-five miles from a triangulation station and a leveling bench mark of standard accuracy. The aim of this work is to make the United States an engineering Utopia, a land where every piece of privately or publicly owned land is bounded by lines run from points of reference made by a Government survey; where engineering work such as dams, railways, canals, bridges, irrigation projects, hydroelectric developments, and tunnels are designed on a system of standardized measurement of the earth's surface, both in the horizontal and vertical planes.

AIRSHIP MAY TAKE BIG LENS ACROSS COUNTRY

THE Navy's airship *Akron*, largest in the world, may be pressed into service to carry to California the giant 200-inch telescope mirror soon to be constructed in an Eastern workshop. When this mighty disk of quartz is completed, probably within two years, its transportation to the telescope site will be a major engineering problem. It is too large to be carried safely on a train. University of California scientists have suggested that the *Akron* might pick up the mirror at the factory and drop it on the still unselected mountain peak near Pasadena, Calif., where it will be used.

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NEW SUBMARINE EAR

(Continued from page 19)

deck of the *Bass*, with his helmet pressed hard against the metal side wall of the conning tower.

Using International Morse code, two quick taps for a dash, one tap for a dot, the diver asked the crew what, if anything, they wanted.

"Send us a bale of hay," shouted a voice within the tower, "and some cigarettes."

The words resounded within the narrow confines of the *Bass's* upper works, filtered through the heavy steel wall and into the diver's helmet.

"Okay," he tapped back, and a few minutes later a basket of groceries was placed on the sub's back porch and the crew lunched on fresh milk and water, sent down in ordinary fruit jars, and canned beef fresh from the Navy commissary.

The *Bass* had gone down earlier in the day to test the delivery of food underwater through one of its two escape hatches. The *Ortolan* followed the *Bass* out from San Diego, searched with grapnels along the bottom of the sea, then sent down divers to locate the *Bass's* exact position and hand food in to the crew.

FOR several months prior to the food exercises, the crews had been trained in the use of Momsen lungs. With these oxygen-filled artificial lungs slung around their necks, they could escape from any sub. This process consists of a half-dozen sailors clambering up into the escape hatch, shutting the water-tight door leading back down into the submarine, then opening the outer door of the hatch. As the water pours in, it fills the hatch up to their necks and they stand with their heads in an air pocket. One by one, they duck down through the door and go up the ascending line to safety.

Now the process is reversed. The food is passed in through the open outer door and deposited in the water. This accomplished, divers on deck close the outer door, the crew below drain the water inside the hatch down into the bilges, then open the lower door and take the packages from the shelf.

When D. A. Frary, ship fitter first class, and H. L. Massingil, quartermaster second class, were ordered to open the *Bass's* hatch and stow several cans and jars of provisions inside, they followed the full routine required in locating a disabled sub and in conducting diving operations toward her deck. Lt. F. W. Corwin, commanding the *Ortolan*, prescribed their respective duties, then sent them down the mooring line.

"We knew," explained Lt. Corwin, who for nineteen years has been an expert Navy diver and rescue vessel commander, "that the grapnel was in the *Bass* somewhere. We planted permanent buoys and moorings in a circle over her. Then we steamed inside the circle and by means of mooring lines could haul the *Ortolan* in any direction.

"The first diver, Frary, went down the rope that was suspended from a cork float. Whether he would step on the conning tower or on the forward safety hatch, no one knew. As it turned out, the grapnel had caught in the submarine's tail. Frary detached the line and walked forward to the conning tower. There he fastened it to the rail, to mark the center of the sub.

"WE SENT down the regular divers' descending line, a flexible braided rope two and one-half inches in diameter. These lines never kink and they're easy on divers' hands as they cling to them while descending or returning to the surface. The second diver, Massingil, then descended with the canvas bag of food slung over his right arm. This left (Continued on page 131)

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TRADE-MARKS

NEW SUBMARINE EAR

(Continued from page 130)

his left hand free to control his valves." But the food was not yet delivered. Massingil did not slide down the rope, shove the food in through a door and return to the surface.

"I deposited the food bag on deck alongside the conning tower," Massingil explained. "Frory received the second buoy line and while he walked through the dark water to the bow, where he made the line fast, I carried a second line to the stern."

"Now we had the sub located. Of course, the crew couldn't eat in comfort unless they had plenty of air. So down the descending line slid two air hoses, held close to the line by shackles. We turned from the rail toward the forward deck. Frory held the hose while I pried open the valve. We fastened the hoses onto the fittings. Through them, the men in the *Bass* who were crowded in the forward torpedo compartment breathed fresh air from above. After we made these connections tight, we stood for a moment looking at each other.

"I moved toward Frory until our helmets touched.

"THE food's next," I shouted. The man on the telephone above probably jumped out of his chair, but the sound reached Frory with normal volume after it had passed through the two helmets. That's the way divers talk to each other when they plod around in the blackness on the ocean's floor.

"We returned to the conning tower where Frory untied the descending line and carried it 125 feet to the after escape hatch. There he tied the line to a rail. I picked up the bag of food and followed Frory.

"Since this was only an experiment, the people inside the *Bass* helped us. Frory tapped out a call for manpower on the inside wheel, and together we swung open the outer door. I squatted as well as anyone can in a bulky diver's suit and took the jars and cans, one at a time, from the bag and arranged them around the wall of the hatch. Then Frory tapped out dashes and dots on the hatch with his hammer again. We screwed the door closed and the boys below soon had their lunch."

NOW that trapped crews can have hot soup and roast beef three times a day, in handy waterproof containers, experiments are being made with non-collapsible hose through which larger volumes of liquid food may be poured. Nothing but air has been pumped down the air lines to date. Since these collapse when the air pressure is turned off, it would be necessary to run liquid foods through the compressors. Thus, to fight back the crushing force of the water, hot soup going down a rubber line would enter the submarine as a fine spray.

While Uncle Sam's submarines roam the deep seas, often in water so deep rescue and salvage vessels could be of no aid, the Navy's major disasters have occurred in shallow water. In 1921, the *S-5* went down on one end in 152 feet of water off Cape May, New Jersey. The following year the *S-48* dropped on one end in 130 feet of water off Bridgeport, Conn. Five years ago the *S-51*, after being rammed by the *City of Rome*, sank in 102 feet off Block Island, R. I. And in 1928, the *S-4*, rammed by a coast guard cutter, went down 114 feet two miles off Provincetown, Mass.

Navy divers have descended many times to depths greater than these and can carry food and make air connections on submarines considerably deeper than 100 feet. William Loughman in 1915 slid 306 feet down a line to inspect the *F-4* at Honolulu.

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"TRAINED SEALS" ARE SEA LIONS

(Continued from page 55)

wild sea lion, free to kill and eat all it wants amid the vast schools of fish in the Pacific, never eats more than four or five pounds of fish a day, and never kills fish except when hungry. I have tried other foods, meats of all kinds, cereals, sugar, and prepared fish foods, but the sea lions will not eat them, except now and then a bit of raw ground beef. Fish is their only food.

My next step is to give each sea lion in the troupe I am training a name, which is to be his for life. In a surprisingly short time, they learn these names, and the individuals will not move, when on the stage, unless each is addressed by its name. Incidentally, I find little difference in the intelligence of males and females, though the latter are less noisy, and possibly become thoroughly tamed a trifle sooner.

I HAD one group of seven sea lions, all from the Coronado Islands, off the west coast of Mexico, that would answer roll call like a lot of schoolboys, each giving a short, sharp bark when its name was called, but paying no attention until its own name was spoken. I have taken individual sea lions, trained to know their names, to the ocean beaches and released them into the surf, without so much as a collar on them. When I called such a lion by name, it invariably came to me, and showed no disposition to remain in the water. Few dogs can be trained to as perfect obedience.

Now and again, however, I find a sea lion that simply cannot learn the name I have given it. Such animals are excellent for exhibition purposes, in zoological gardens or in circuses, and so are returned to the large pool, where they aid in the domestication of other sea lions by showing their confidence in man. Others are so intelligent that they may be taught to count up to four or five, by barking the proper number of times for the figure called to them.

After I have obtained the complete confidence of the group, I weed out those that lack intelligence. This usually requires about three months. How they hate to leave the group! When taken back to the large pool, they struggle against going, protesting by barking and even by snapping at the hands that lift them into the truck. One large but dumb bull, about four years old, broke out of the pool fence and returned to the training quarters, where I found him, early one morning, holding a grumbling conversation with six other sea lions inside.

ONCE they have learned their tricks, and the order in which they are called on to perform them during the act, sea lions object vigorously and vociferously to any change in that order. They also will refuse to leave the stage until they have been through the entire act. One of the well-trained young cow sea lions in a troupe I trained would get down off her stool, cross the stage to me, and nudge me, first gently and then harder and harder, if I eliminated one of her tricks, or sent her through them in the wrong order.

When every member of a troupe answers quickly to its name, I start teaching two simple expressions—"Hup!" meaning that the animal shall get up on its stool or platform immediately, and "Hit!" meaning that it shall do its particular trick with the toy I give it. These toys may be small rubber balls, beach balls, dumb-bells, batons, torches, or whatever sort of equipment I have taught them to use. Next comes "All right," and "That's good." I use the first of these to get the troupe down off their stands and off the stage, and the (Continued on page 133)

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"TRAINED SEALS" ARE SEA LIONS

(Continued from page 132)

second as a signal that the individual performer has completed his trick to my satisfaction. Invariably, it is accompanied with a piece of fish.

These are virtually all the words I use, with the exception of the names I have given them. "Steady," is used to encourage the sea lion doing an act, especially a balancing trick, in which the animal may be about to drop the baton or ball, much as a rider speaks to a nervous horse. Their reward is always a piece of fish. Their only punishment is my refusal to permit the disobedient one to go on with its act. Nothing reacts so severely on these intelligent and sensitive animals as this. To turn from one of them in the middle of its act and start another with its tricks is far worse punishment than a whipping.

Sometimes sea lions originate tricks of their own. I had one cow, about three years old, who would lean back on her hind flippers and clap her front flippers together every time she saw me approaching with a pail of fish. This gave me an idea, and I taught her six companions to clap their flippers in the same manner whenever I gave one of them a piece of fish. This made it seem to the audience that the lions were applauding a trick well done by their fellow-actors, and this won much applause for the sea lions.

I HAD another, a young bull, who learned his tricks rapidly, but objected to climbing up on his stool in line with the others of the troupe. Whenever I ordered "Hup!" he would flop over to his stool, back off, turn around, face me, and start grumbling, growling, and finally barking. By rewarding him with a piece of fish every time he did this, provided that he eventually got up on the stool, we developed an act that seemed to show the sea lion and his trainer in an argument.

It also strengthened the public's belief in the "power of the human eye," whatever that is, for I never spoke to the sea lion, other than the single word of original command, but stared at him constantly while he went through his "argument." In the end, he seemed cowed by that stare into doing what he was told to do. As a matter of fact, he obeyed at last in order to get the much-coveted piece of fish.

From two to three years are required to complete the training of a sea lion of average intelligence and tractability, though I have taught individuals that were ready for the stage in eighteen months. I have with me now a yearling bull, "Sunny Boy," one of the youngest I ever have attempted to train, who will be a finished performer by the time he is a little more than two years old. I have had others that would not be ready for the stage in ten years, though they were good-natured and willing as any animal could be. Like some children, they simply could not learn.

BRIDGE BUILDER GETS LONGEST STEEL TAPE

WHAT is said to be the longest steel surveyor's tape in the world has just been completed by a New Jersey instrument maker for an American bridge concern. It will be used to measure exact distances between piers in building huge spans. Instead of being marked off in inches, the thin ribbon of steel, almost a quarter of a mile long, is marked at 100-foot intervals. In order to stretch the tape to full length, so accurate readings can be taken, a pull on the end of exactly seventy pounds is required.

"LOOK... he's imitating a pianist!" someone shouted

—then a queer thing happened

Jack had strummed some "Blues" for us on his uke. We were all set for dancing when—the radio refused to work! "Don't mind, folks," said Tom. "The party is saved! Joe, here, has kindly offered to enliven the proceedings with a piano solo..."

This promised to be good—for, as we all knew, Joe couldn't play a note. Suddenly someone shouted:

"Get this! Look—he's imitating a pianist!" Joe waited a moment to command silence. Then, to our complete amazement he struck the first bars of "Sing Something Simple!" Couple after couple glided around the floor. When Joe stopped playing the house shook with applause. I was dumfounded. Joe had always seemed to be a "born wall-flower"—yet now... I determined to solve the puzzle.

"How on earth did you do it?" I demanded. He laughed. "Why, it was easy! I simply took that home-study course in music your cousin told us about... There wasn't any expensive private teacher to pay—and since the lessons came by mail, I didn't have to set aside valuable hours for study. Before I knew it I was playing simple pieces by note and... well, anybody can learn to play the U. S. School of Music Way!" This story is typical. You, too, can learn to play your



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Far Back in the Times of the Primitive Herdsman We Find the Origin of PECUNIARY

In the days before money was created, a man's wealth was reckoned in flocks and herds. The Latin word *pecus* meant "cattle," and from that word came *pecunia* meaning "property in cattle." As civilization advanced and a man's wealth was represented by things other than cattle, the same word was used to designate his property. Then, when money was adopted as the measurement of wealth, the word *pecunia* took on the new meaning "money." From this came *pecuniarius*, "relating to or consisting of money," from which we have our word *pecuniary*, with the same meaning. There are thousands of such stories about the origins of English words in

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A definite program for getting ahead financially will be found on page four of this issue.

FINGERPRINTS, AID OF MAN HUNTERS

(Continued from page 36)

document which was brought out by chemicals more than three years after it was made. In another instance, a Brooklyn, N. Y., burglar tried to destroy fingerprints left on pieces of glass, handled in breaking into a millinery shop, by dropping them into a barrel of water. Detectives retrieved the glass after it had been submerged twenty-four hours and developed perfect prints of the burglar's thumb and forefinger.

Usually, fine powder which adheres to the lines of grease is used to develop the unseen "calling cards" that criminals unwittingly leave behind. The color of the powder is chosen according to the background. Revolver handles, for instance, are dusted usually with white clay powder; white smooth-surfaced paper with black graphite, charcoal, or ordinary lampblack; while for dark tables and other furniture, aluminum powder or a combination of chalk and mercury is used. When fingerprints are developed with aluminum powder, they are copied by pressing on them gently a thin mass of black gelatin and glycerin. This copied fingerprint is then protected by a celluloid cover until it is photographed.

IN SPECIAL cases, ink is brushed lightly over a spot where a fingerprint is believed to be. The oily lines repel the ink, leaving the ridges light and the valleys dark when the pattern becomes visible. For rough fabrics and some papers, vapor reagents, such as iodine or osmic acid vapors, are used. Iodine vapor is most sensitive but the latent prints it brings out soon fade. Osmic acid, on the other hand, leaves a permanent print, but fails to develop faint marks.

For covering large objects like safe doors and table tops with powder, the fingerprint men of the New York City headquarters are equipped with compact machines that scatter the dust evenly and then blow away the superfluous particles. Ordinarily, the powder is spread with a fine camel's-hair brush.

At Los Angeles, Calif., Milton F. Nuremberg, fingerprint expert of the sheriff's office, once made use of an ingenious makeshift for developing latent prints. Called hurriedly to the scene of a crime, he found he had left his "fingerprint dust" behind. Standing beside him was a deputy sheriff puffing a black cigar. Nuremberg borrowed the cigar, dusted ashes over the latent print and obtained fully as good results as with his regular equipment!

This same scientific sleuth solved a baffling problem of identification, a few years ago, when bootleggers used a novel means of putting a confederate "on the spot." Explosive fumes were allowed to fill a barn that housed the secret still of the gang. The victim entered the building, struck a match, and instantly was enveloped in roaring flames. The body of the victim was charred beyond recognition.

NUREMBERG conceived the idea of peeling the skin off the fingers, softening it with alcohol and glycerin and then applying a chalk solution that filled the depressions between the ridges. The contrast between the white chalk and the blackened skin, thus obtained, enabled him to get clear photographs of seven distinct fingerprints. These identified the victim and put the police on the trail of his murderers.

Moulage, a recently-introduced colloidal substance, permits the fingerprint detective to copy marks left by a slayer's fingers upon the skin of the victim. In Vienna, Austria, not long ago, a moulage cast of the neck of a strangled woman revealed fingerprints that led to the arrest of her murderer.

Black light and X-rays are two of the latest aids added to the equipment of the fingerprint ace. Recently, Luke S. May traced a poison pen letter to its sender by discovering, through the use of ultra-violet rays, a latent fingerprint on the stationery. A European expert has devised a system of adding an X-ray picture to the fingerprint to reveal peculiarities of the bones and joints of the finger as an added check upon identity.

Was a mark made by a finger on the right or left hand? That is a question the scientific sleuth must frequently answer in the solution of crime. On the right hand, it has been noted, the ridges of the loops most frequently run off the bulb of the finger to the right, and on the left hand to the left. Three or four years ago, this knowledge brought to a quick conclusion the mystery of a fiendishly-plotted "Million-Dollar Suicide Murder."

In his bathroom, a rich manufacturer was found dead, his throat slashed and a razor lying nearby. The verdict would have been "suicide" if a young fingerprint expert had not examined a bloody fingerprint on the left wrist of the victim, which was at first believed to have resulted from his gripping his own wrist during the death agony. Instantly, the detective pronounced it murder, for the imprint on the left wrist had been made by the thumb of a left hand!

LATER, a nephew, heir to the manufacturer's fortune, was charged with the murder. He confessed he had planned it carefully to appear a suicide. The one overlooked thumb print, however, gave the clue that concentrated the police on a search for evidence before the malignant plotter could cover his tracks.

In the great metal archives at Washington, which hold the fingerprint records of American criminals, the filing is so arranged that a given print can be located in less than five minutes. All requests for information telegraphed in are answered in one hour and all letters received are replied to within twenty-four hours. Nineteen hundred arrests were credited to information received in this way during last year alone.

The filing is done under four general classifications: 1. Fingerprints having loops—that is, with the ridges making a hairpin turn. 2. Those having whorls, with ridges turning through a complete circuit. 3. Those containing arches, the ridges forming a sweeping upward curve as they cross the bulb of finger. 4. Composites, or combinations of the other three. Under these four general groups come 1,024 sub-classifications that make accurate filing possible.

THE fingerprints of most people, about sixty percent, contain loops; those of about thirty-five percent contain whorls, including composites, and those of about five percent, arches. Because it has been noted that in some families, seventy-five or a hundred percent of the members will have arches, which in general are infrequent, attempts have been made to trace paternity through the pattern of the ridges on a child's hand. Also, scientists have tried to classify the races by fingerprints, but with only partial success. One interesting thing they have discovered is that, of all races, the negro has the clearest fingerprints.

Probably the most sensational development in the science of fingerprinting is Dr. Edmund Locard's study of the pores along the tops of the ridges. This famous scientific detective of Lyon, France, reports that the shape, size and number of these sweat pores are different in different individuals. The number of openings per square (Continued on page 135)

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If you have invented a new appliance and are seeking a manufacturer—or if you are a manufacturer seeking a new product to add to your line, a small announcement in the pages of Popular Science Monthly should put you directly in touch with numerous possibilities.

We receive a constant stream of letters from inventors and manufacturers seeking contact with each other. We know from years of handling this correspondence that there are innumerable opportunities for inventors and manufacturers among the readers of Popular Science Monthly.

The Popular Science Monthly Marketing Service will be glad to help in the preparation of a small advertising announcement. Address

MARKETING SERVICE BUREAU
Advertising Department
Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

FINGERPRINTS—AID OF THE MANHUNTERS

(Continued from page 134)

inch, he found, ranges from sixty to one hundred and seventy.

By means of his "dactyloscope," a special pore-studying super-powerful microscope, Locard trapped a notorious jewel thief operating in Lyon. In removing the gems, the burglar had handled a rosewood jewel case. At the trial, Locard showed that the middle finger of the crook's left hand contained 901 pores, which coincided exactly with one of the imprints on the box! As a result of this spectacular scientific testimony, the guilty man was sentenced to five years of hard labor.

Thrillers of fiction and nerve-tinglers of melodrama have often centered about master crooks who wore magic gloves that left the fingerprints of innocent people at the scene of a crime. Could this be done in real life?

The unanimous answer of the scientific sleuths with whom I talked was: no. The lines and ridges might be duplicated, I was told, but they would leave no characteristic marks of secretion from the sweat pores, and the absence of the pores themselves would be evident in the forgery. Under the lens of a Locard's dactyloscope, a fake fingerprint could be distinguished in an instant.

AS I complete this installment of the amazing story of science's many-sided battle with crime, the morning papers carry three headlines that tell of criminals brought to justice. One reports the solution of a mysterious murder in England, another the capture of a big-time burglar in Illinois, the third the trapping of a poison pen letter writer in California.

Occurring in widely-scattered parts of the globe, these three cases have one thing in common. Each was solved through the identification of fingerprints. And this is not exceptional. Practically every day in the year, the spotlight of the news reveals similar instances. For fingerprinting, today, forms the heavy artillery in the army battling on the crime front throughout the world.

NEXT MONTH: *Trapping the penmen of the underworld. Learn how the lives of innocent victims and the fate of millions of dollars may hang on the tail of a comma or the shape of an "o." Read the thrilling story of how handwriting experts detect forgeries and track down blackmailers. Watch for it in the April POPULAR SCIENCE MONTHLY. Out March 1.*

SCRAMBLE TELEVISION TO KEEP IT SECRET

SECRET transmission of television images is proposed through a method with which an Eastern firm is experimenting. The image would be distorted optically by lenses at the transmitting end, so that ordinary television receivers in general use would get only a blurred and meaningless picture. But a receiver equipped with the proper lenses of secret curvature would be able to restore the image to its proper shape. In this way, it has been suggested, international conferences might be held privately without the need of any participant leaving his country, and business contracts could be executed with the parties meeting face to face by television. Methods have already been perfected whereby conversation may be "scrambled" for secret transmission. A system of electrical scrambling is now in use in transmitting point to point telephone conversations across the Atlantic ocean.

J. E. Smith
President

National Radio
Institute

**I am
Doubling
and
Tripling
Salaries**

**Many of
My Men
Earn \$50
\$75, \$100
a Week**



I'll Train You at Home to Fill a BIG PAY Job in Radio

IF YOU ARE earning a penny less than \$50 a week, send for my book of information on the opportunities in Radio. It's FREE. Mail the coupon now. A flood of gold is pouring into this new industry. Thousands of fine jobs open every year. My training fits you for all lines—manufacturing, selling, servicing sets, in business for yourself, operating on board ship or in a broadcasting station, television, aircraft Radio, and many others. My FREE book gives you full information on Radio's many opportunities for big success and how you can quickly learn at home to be a Radio Expert.

Many Make \$50 to \$100 a Week

Why go along at \$25, \$30 or \$45 a week when you can get ready in a short time for Radio where the good jobs pay \$50, \$75 and \$100 a week. Get into this live-wire field of quick success.

Your Training Need Not Cost You a Cent

Hold your job. I'll not only train you in a few hours of your spare time a week, but the day you enroll I'll show you 28 ways to make money on the side repairing, installing, selling Radio sets in your neighborhood. I give you Home Experimental outfits that teach you to build and service practically every type of receiving set made. G. W. Page, 2210 8th Ave., S. Nashville, Tenn., writes: "I picked up \$935 in my spare time while taking your course."

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My book has shown hundreds of fellows how to make more money and win success. Investigate. Find out what Radio offers you, how my Employment Department helps you get a job after graduation, and the many other features of my training. Mail the coupon for your copy **RIGHT NOW**. J. E. Smith, President, Dept. 2CP3, National Radio Institute, Washington, D. C.

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Dear Mr. Smith: Send me your free book, explaining your home-study training and Radio's opportunities for bigger pay. I understand this places me under no obligation and that no salesman will call.

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Broadcasting Stations need trained men continually for jobs paying \$1,200 to \$5,000 a year.



Aviation is needing more and more trained Radio men. Operators employed through Civil Service Commission earn \$1,620 to \$2,800 a year.



Spare time set servicing is paying N. R. L. men \$200 to \$1,000 a year. Full time men are making as much as \$75, \$100 a week.

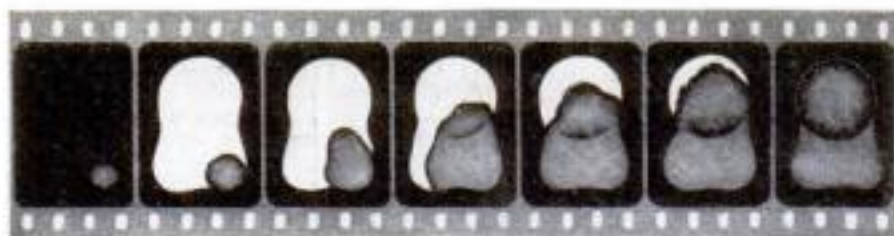


Talking Movies—an invention made possible only by Radio—offers many fine jobs to well-trained Radio men, paying \$75 to \$200 a week.

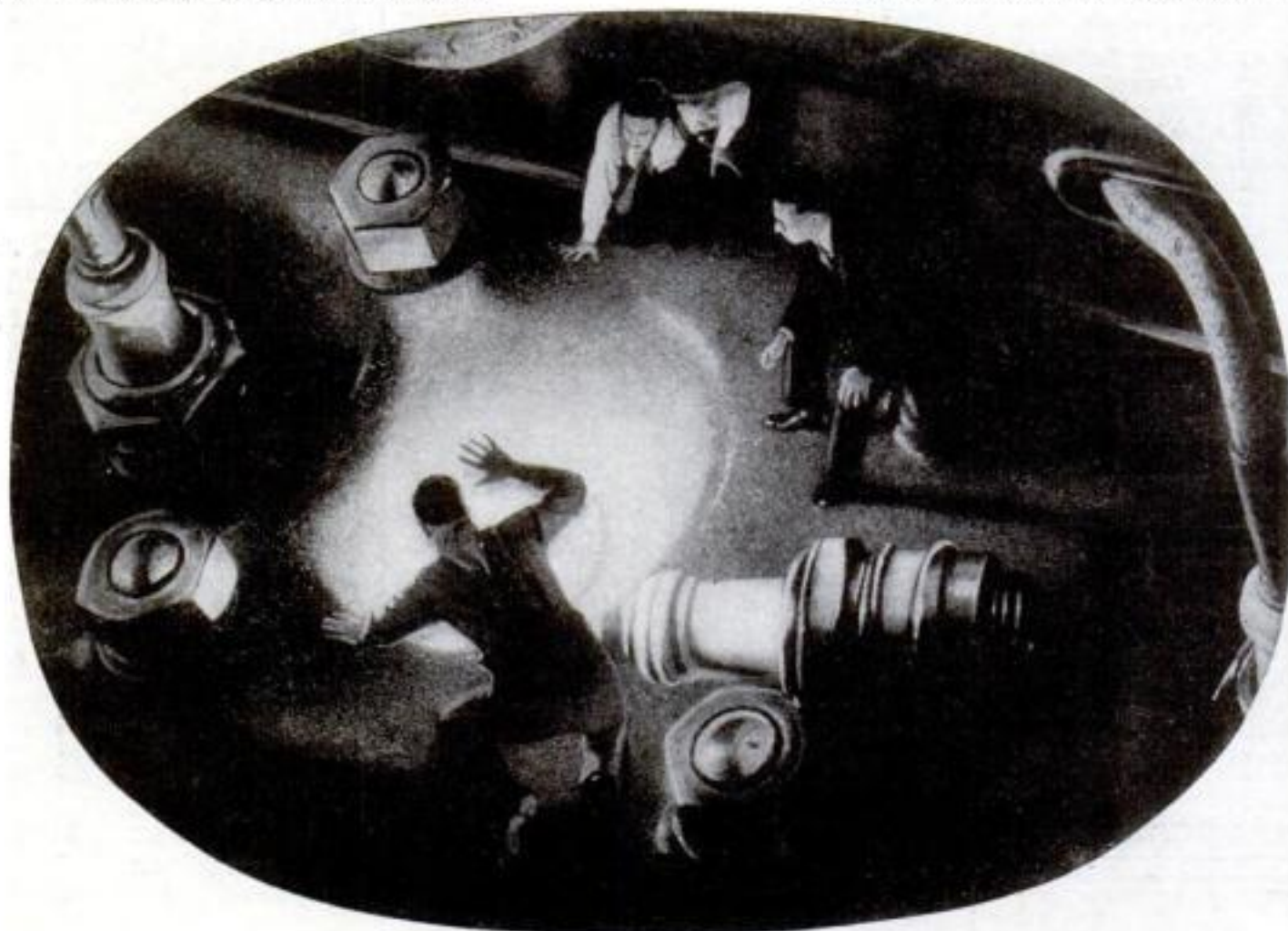




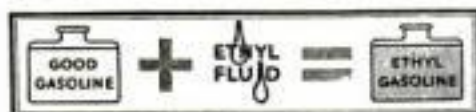
ORDINARY GASOLINE is in the cylinder. You see the spark in the picture at the left. In the next the gasoline vapor starts to burn. More—more—more burns. Then suddenly, in the sixth picture—BANG! The remaining gasoline explodes. That is KNOCK. The last picture shows nothing but after-glow. Knock wasted the gasoline that should be working now.



ETHYL GASOLINE starts from the spark in the same way—as shown in the first three pictures. But Ethyl can burn at only one speed: *the right speed*. See how its flame spreads *evenly* from start to finish. It is not all burned until the last picture—delivering its greatest power when the piston is going down—when power counts most in the performance of your car.



Look *INSIDE* the engine *There's where Ethyl proves its value*



The quality of Ethyl Gasoline is maintained by laboratory inspection of samples collected daily. Ethyl fluid contains lead.

SEEING is believing. You can now *see* the difference Ethyl makes in gasoline. By the use of special instruments and high-speed photography, engineers have made pictures of the actual combustion of motor fuels.

Look at the two strips above. They show what happens in that important 1/100th of a second after the spark plug fires. At the left, you see ordinary gasoline failing under the strain of a modern high compression engine. You *see* the uneven explosion that causes harmful knock, overheating and loss of power when you use ordinary gasoline in your car. At the right you

see how Ethyl Gasoline burns smoothly, evenly, powerfully—in the test engine or in any engine—at any load.

That is why car manufacturers now offer high compression engines either as standard or optional equipment. These engines are *designed* to take full advantage of the high quality of Ethyl and its universal distribution by oil companies. Car manufacturers know that Ethyl makes *any* car run at its best.

Look for the pump with the Ethyl emblem on it next time you buy—and *feel* the difference Ethyl makes. Ethyl Gasoline Corporation, New York City.

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Buy ETHYL GASOLINE



Should she have been frank?

THIS is a case where a woman paid a high price for silence. Like so many other commendable people she kept small irritations to herself. It was hard for her to speak out—even though a frank discussion might have smoothed trouble away.

Little things continually cropped up to mar her happiness. Possibly she should have overlooked them entirely. Certainly it was a grave mistake to harbor bitter thoughts. She allowed petty annoyances to pile up until her patience was almost exhausted. Then her husband grew a bit careless in his appearance—even failed to shave as often or as carefully as he should.

She called this the "last straw" and left him.

• • •

Is a woman correct in assuming a man is losing respect for her or himself when he becomes careless about shaving? We think not—discomfort is a more likely reason—although stubble is a handicap in almost every business or social contact. May we suggest today's Gillette blade is the answer in cases like this.

This blade is far keener and smoother—invites frequent, close shaving. Once or twice daily use will not irritate the tenderest skin. We urge you to try this remarkable blade on our positive money-back guarantee. If you don't agree every shave is by far the cleanest and smoothest you have ever enjoyed—return the package to your dealer and he'll refund the purchase price.

Gillette

RAZORS  BLADES

NATURALLY FRESH

never parched, never toasted!

The cool, flavorful *freshness* of Camel cigarettes is purely a natural product.

It is attained not by any mysterious processes, but simply by preserving the full natural goodness of fine sun-ripened tobaccos.

These choice tobaccos of which Camels are blended — fine Turkish and mild Domestic tobaccos — are never parched or toasted.

On the contrary we exercise every care and

precaution to safeguard the natural moisture which is infused with their mildness and flavor.

That's why the Camel Humidor Pack is such a boon to Camel smokers — it could do little or nothing except for the fact that the cigarettes we put into it are fresh to start with.

To see what that means in cool, smooth, throat-friendly smoking pleasure, switch to *fresh* Camels for just one day — then leave them, if you can!

R. J. REYNOLDS TOBACCO COMPANY, Winston-Salem, N. C.

R. J. Reynolds Tobacco Company's Coast-to-Coast Radio Programs

CAMEL QUARTER HOUR, Morton Downey, Tony Wons, and Camel Orchestra, direction Jacques Renard, every night except Sunday, Columbia Broadcasting System

PRINCE ALBERT QUARTER HOUR, Alice Joy, "Old Hunch" and Prince Albert Orchestra, every night except Sunday, N. B. C. Red Network

See radio page of local newspaper for time

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• Don't remove the moisture-proof wrapping from your package of Camels after you open it. The Camel Humidor Pack is protection against perfume and powder odors, dust and germs. In offices and homes, even in the dry atmosphere of artificial heat, the Camel Humidor Pack delivers fresh Camels and keeps them right until the last one has been smoked

CAMELS

Made FRESH — Kept FRESH